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THE COMET OF A SEASON.

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CHAPTER XXXVI.

"THE POWER THAT MADE BOY AND GIRL."

NEVER were there more miserable days than those which Clement Hope was now passing. He suffered intensely, and all the more because it seemed to him that he had no right to complain. His idle and transient passion for Melissa, that unreal boyish affectation of love, had been foolishly cherished by him, and ostentatiously exhibited and proclaimed after the fashion of youth, when it is pleased to fancy itself in love, and is proud of its own sham and self-delusion. He hated to think of this now. He looked back with shame and anger upon his former rhapsodies, and ravings, and attitudinisings as the hopeless lover of poor Melissa. Such folly, he felt, took away from him now all right to complain. Why should Geraldine think for a moment of one like him, whom she had seen only the other day apparently steeped in love for another girl, a girl far beneath her own level in intellect and in heart, and how could she now be expected to regard him in any serious light? She could but laugh at him and despise him. Only for his colonisation scheme, and its incessant demands and details, Clement sometimes felt as if his life could not go on; as if he must have ended all the difficulty by going out of his senses. The nights above all were trying to him. He came home late and tired to the lonely house looking on the dismal canal, and he could not sleep. He mounted the little observatory on the roof, and looked abroad over the trees

and grass of the park, and saw the sky reddened by the lights of the great city. He outwatched the bear and the "sun of the sleepless," the "melancholy star," and only fell into a fitful sleep at last when morning had come and the roads and streets began to be alive again. Sometimes he went out before the dawn, and wandered about the roads, and climbed a little hill in the neighbourhood, from which he had a confused view of London shining somewhere in the near distance, like a mass of glowworms in a hollow. He hated the lonely ghostly house, and yet he would not leave it to live anywhere else. He would not leave it even for a night. He felt a kind of savage self-torturing pleasure in condemning himself to its loneliness and its shadows and its memories. Day and night the one feeling possessed him. He had found out his love too late, and had found out at the same time that he was not worthy of such a love.

Sometimes he raged at Geraldine, and told himself that she was marrying only for money, for a home, for position; that she was throwing away her youth and her beauty and her intellect on a man old enough to be her father, selling herself, as many another girl was doing, for mere worldly advantage. Such a thought filling him for the time with an angry feeling against the girl gave him the momentary courage of resentment. But he soon found that courage bought at such a cost is not worth having even to a disappointed lover. It is only like the courage supplied by the maddening stimulus of some strong drink. It is factitious and unwholesome, and leaves its dismal hours of reaction and depression, its lonely wasting heartache, instead of the headache which the other excitement bequeaths in dying. And, besides, Clement was not in his right mind when he allowed such a thought to possess him, even for a moment. He knew this. He never could believe anything evil of Geraldine. Let her motive be what it would, it must be a good one and worthy of her. He could only suppose that she either did love Captain Marion—after all, such things had happened—or that she felt she could care for no one else in the sense of deepest love, and was therefore willing to marry a man for whom she had a sincere respect and affection. Anyhow, it was all the same to Clement. She was lost to him. She never could even know how truly he loved her, and how fully he appreciated her. That bitter immemorial remonstrance with fate which the disappointed lover makes, "if she could only know"—"if she could only understand all"—that remonstrance was always in Clement's heart, if not on his lips. He himself had rendered this impossible. She never could know him as he really was, never could understand that his love for

her was deep and real, and even in his sufferings he could not hope for kindly sympathy. Nothing was left for him but to go away and never to come back again. On this he was resolved; he would not return to England.

While in this mood he received one day a few friendly lines from Montana, thanking him for the part he had taken in the rescue on Tower Hill, and expressing a regret that they could not meet again before Montana left for America. At once the thought came into Clement's mind, "Why wait any longer? Why not go to America at once, and in the vessel with Montana?" The thought became a resolve. He wrote to Montana, and told him of his determination.

The thought that he was to leave England so soon gave Clement new strength and courage. Say what we will, we can none of us in our souls believe that in changing our skies we do not change our hearts. It is impossible not to indulge in the fond fancy that every grief is cured, that every disappointment is redeemed and repaired by the simple process of going away. Peace always seems to be on the other side of yonder purpling mountains; peace, too, and refreshment to the weary heart will always seem to lie, a shadowy land of gold, across the sea. The thought of going away is almost like the knowledge of coming death; it pacifies wild emotions, makes disappointment seem a trivial thing, and vaguely promises a renewal of love and hope and youth. So Clement began to feel, now that his going away from England was but a question of days. Willingly would he, with Byron's hero, have told the vessel that was to carry him that he cared not "what land thou bearst me to, so not again to mine." Such were Clement Hope's feelings; and for the hour they were as strong and as sincere as human feelings well can be. He was in the true exile mood—unless things should change.

Meanwhile, Lady Vanessa's words had sounded a note of alarm in Captain Marion's mind. The alarm was the more keen because the impression given from outside only corresponded, after all, with a certain impression that had long been forming itself within. In order to continue even moderately satisfied with himself, Marion had had to assure himself many times of late that he was doing the best thing he could for Geraldine in marrying her. He sometimes found himself looking at her with a certain tender and pitying glance, contrasting for the moment her bright youth with his advancing years, and wondering to himself whether a girl, however high-minded and devoted, could be happy with a husband so much older than herself. "It is all very well," he used to think, "for the present"—used to think, that is to say, in his moments of doubt and despon-

dency—"It is all very well for the present—or not all very well—but how will it be ten years hence, when she is little more than thirty—and a married woman is only in her prime then—and I shall be far on the shady side of sixty? Am I doing wrong to the girl? She is only marrying me to please me. Am I doing a mean and shabby thing?" Then, again, as Geraldine brightened up when he talked to her, he told himself it was all for the best, that he would make her happy, that he would be perhaps more devoted to her than a younger man might be, and he looked around the circle of those whom he knew, and he saw no young man worthy of her whom he could suppose Geraldine would marry. Many a time the idea came to his mind that if Clement Hope had not been so absurd as to fall in love with Melissa, he would have been a young man whom Geraldine might have cared for. For a time Captain Marion could always remind himself that he was saving Geraldine from the influence of Montana, and at Geraldine's own request. How unlucky, he thought again and again, that Montana should ever have come amongst them. Who could have supposed that the influence of any one man could be so strangely disturbing to a whole group of people? Nothing was the same since Montana came. Marion's daughters were not the same to him. Katherine and her husband were not the same. Melissa was not the same. Mr. Aquitaine was not the same. Geraldine and Marion were thrown together strangely in a manner hardly welcome to either, utterly unexpected, and all because of Montana's coming. This mood of occasional doubt and occasional reassurance prevailed until Montana's offer of marriage to Melissa and her acceptance. Then Captain Marion's position became one of still greater doubt. Now that Geraldine was free from the importunity of Montana, and from what she seemed to think the dangerous spell of his influence over her, how would she feel with regard to her engagement to marry Marion?

While such doubts were filling his mind came Lady Vanessa's direct outspoken words. Marion for a moment felt a pang of jealousy as keen as if he had been really a young man madly in love with Geraldine, and had been deceived by her. He went home that day determined to open his eyes and see for himself; determined, too, for all his pangs of jealousy, to take care that Geraldine's happiness was cared for, whatever might occur, first of all. He thought of going directly to Geraldine and asking her, but, after a moment's reflection, he felt that this would be a rough and clumsy step to take. Geraldine was a candid girl, and she had never yet hinted to him or allowed him to suspect that she cared for anyone more than for

him. She was a girl, as he knew, with a strict sense of duty, and he did not believe that she would have consented to marry him if she was conscious of loving someone else. It might well be, then, supposing there were any truth in Lady Vanessa's conjecture at all, that Geraldine was not yet conscious of any strong feeling towards Clement Hope, or, at least, that she did not quite know the nature of the feeling, and only took that for warm friendship which was genuine love. Of course, it might be that Lady Vanessa was mistaken. That sprightly lady seemed the kind of woman who would jump to conclusions very quickly, and who, taking a lively interest in other people's affairs, would be apt to go wrong as often as she went right. So Captain Marion thought he would quietly watch over Geraldine—"watch over her" is an expression that much better describes his feelings towards the girl than if we had said he determined to watch her—and if he saw any reason whatever to believe that she was keeping up her engagement to him out of mere devotion, or kindness, or reluctance to draw back, he would set her free and try to make her happy. In truth, he would be making no great sacrifice in this, for he felt far too much doubt and dread about the hasty engagement to find much happiness in it. His was not, we are ready to admit, a very heroic nature. He ought to have known his own mind from the beginning. He ought not to have acted upon impulse. He ought to have been strong and clear of soul. But we are not describing a man who felt and said and did exactly all that he ought to have said and felt and done, and at precisely the right time. We are only describing Captain Marion. If anyone condemns or dislikes Captain Marion for his weakness and his errors, we can only say that we think he is in many things to be condemned, although not to be disliked. It is certain, at all events, that the world is not filled with strong heroic men who never make mistakes, and if there are more such persons than we have hitherto seemed to take account of, there may perhaps be all the more excuse for Captain Marion, because he will then be only one of an insignificant few.

One merit at least Captain Marion had; he was determined that others should not suffer for his mistakes, if he could only see his way to put things straight once more. His one great anxiety now was to be guided in some way to the doing of this aright.

While Marion was still in this anxiety there came a letter from Clement Hope, telling him that he had made up his mind to go to America at once, and in a few words of generous feeling taking what seemed to be a final leave of his friends. Marion felt that now the opportunity had come. He wrote to Clement begging him to come

and see him next day, or some early day, and insisting that he must not leave town without a farewell in person. So Clement came the next day, and Marion had a long talk with him, and did not find much difficulty in getting at the fact that the young man's resolve to settle in America, and not return to England any more, was not by any means the result of a philanthropic anxiety to cast in his lot for ever with the people of the new colony.

"You must see Geraldine Rowan before you go," Marion said suddenly.

Clement coloured so highly that Marion felt his own cheek redden in sympathy. It was not difficult to read that little heart-secret, Marion thought.

"I don't think it would be right to disturb her," Clement said slowly. "I don't suppose she will expect to see me. No, I think not, Captain Marion. Why should I put her to the trouble?"

"I am sure she will expect to see you. Let me go and ask her."

"No, thanks, no, I couldn't think of it," Clement said. "She must not be disturbed. You will say everything kind for me to her, and you will let me know how you are all going on, won't you?"

He brought out these words in a stammering, almost choking, voice.

"Wait a moment," Marion said promptly, "I will go and see Miss Rowan." He hurried out of the room, and he was lucky enough to find Geraldine alone.

"Geraldine," he said gravely, "Clement Hope has come to see me. He is going away to America at once. He is going with Montana, and he tells me he has no intention of ever coming back again. Won't you see him before he goes—for the last time?"

Geraldine turned pale and trembled. Even if Captain Marion had suspected nothing before, he must have seen by her agitation that the news was a shock to her, more great than even the parting with a dear friend could have given.

"I don't think I should like to see him," she said. "I think I had better not, Captain Marion. No, I think I'll not see him." She looked up and met his enquiring eyes, and her eyes did not venture to remain fixed on his. They dropped with a half scared, half guilty expression.

"Geraldine," Marion said, going up to her, and taking her hand, "I wonder, have you been quite candid with me of late?"

She looked at him now with a little more courage. "I should always like to be candid with you," she said.

"Is Clement Hope in love with you?"

Geraldine stopped for a moment. Then she looked up and answered quietly:

"He said so—once; but he did not know, when he was saying so—he did not know anything. He would not have said a word of the kind, I am sure, if he had known. I told him not, and he will never say so again," she added piteously.

"You did not tell me this."

"I could not," said Geraldine. "It was not my secret, but his. I could not tell about him."

"Come, tell me; you know I only care about your happiness."

"I did not know at the time," Geraldine pleaded. "Oh, Captain Marion, I did not know; indeed, I never thought of anything of the kind. I did not understand my own feelings. But it does not matter. I will keep them down and conquer them. I could not have told you of this at the time"—she meant to say, "at the time when I promised to marry you," but she baulked at the words—"Indeed, indeed, I never had any thought of it myself."

"But it is so?" Marion said gently.

"Oh, forgive me; forgive me," poor Geraldine said. "It is so—it is so, if you must know it. Can you ever forgive me?"

"Why, yes, girl," Marion answered cheerily. "You know very well that I only offered you a sort of asylum to save you from being worried by Montana. That was how it all began. I offered you a raft when there seemed no chance of your having passage in a better vessel. But now that the better chance has come, I am only too glad to give it to you."

"Oh, how can I?" Geraldine asked; "how can I treat you so, and abuse your kindness? You are always so kind and dear to me, like a father."

"Quite so," Marion said, with a smile; "there it is, Geraldine. I was like a father to you, and felt like a father, and I never ought to have allowed myself to think of you in any other way than as a daughter. But I wanted to save you from trouble, and I didn't know of anything that was going on, and I had not my eyes open, I suppose; but anyhow, perhaps I cannot be blamed, since you did not know it yourself. There is one good thing, girl; nobody knows a word about all this except Montana, and he won't tell on us. I think my Katherine suspected something. She has prying eyes, and a rather prattling tongue; but she won't be likely to talk so much now as she might at some other time. She has her own affairs to think of. It is all right, Geraldine. Nobody will know, and I am happy in the thought of making you happy."

"But this is all uncertain," Geraldine said. "He has not asked me. I didn't know he was going away. He might have told me that much, at least." She was inclined to be angry with Clement.

"See him for a few moments," Marion said, "and tell him to write to you. That will be enough; don't say any more. You need not. He must go out to America and do something, and show himself a man of spirit and energy. When he has done that, things will come all right. Of course, you could not rush into an engagement with him as you might rush into an engagement with me. His, I fancy, would not be got out of so easily, or with so little pain on either side."

There was nothing ironical in these words. Marion was saying merely what he felt. As he left the room, some words that occur in "Faust" about "the Power that made boy and girl" came into his recollection. They are used by Mephistopheles; but Marion did not remember that at the moment, and he put them to a better application than would have delighted Mephistopheles. "The Power that made boy and girl," Marion said to himself, "made them for one another."

Chapter XXXVII.

"Every wise man's son doth know."

As Marion was on his way to Clement Hope he encountered Katherine Trescoe. A few days before Marion would gladly have avoided meeting his daughter. He would have dreaded her inquisitive glances and her saucy suggestive words. Now he felt free to meet her with a high head. "No wonder I was ashamed to meet the girl," he thought; "fancy a man of my age persuading a girl as young as his own youngest daughter to marry him!" He felt all the more drawn towards Katherine because of the consciousness that he had gone so near to doing a foolish thing. "Why should I have blamed her so much?" was his thought. Katherine seemed now to appeal to sympathy. Captain Marion need not have feared her glances or her words, so far as he was concerned. Poor Katherine's glances had lost their inquisitiveness of late, and her words had ceased to be saucy. She was concerned about her own life and her future more than about the doings and the follies of others.

Captain Marion barred her passage:

"Well, Kitty, when are you off for Paris? You had better get

under way as fast as you can; it will be growing late. We shall be after you almost at once. What does Frank say?"

"I don't know, papa dear," Katherine answered; and her look was very piteous. "I haven't seen Frank since morning. He hardly ever speaks to me now." Her eyes were filling with tears.

"Frank's in the house, my dear; he is in the library; I saw him there ten minutes ago."

"Is he? I didn't know."

"Look here, Kitty; don't be foolish. Frank's a very good fellow at heart, and awfully fond of you, if you would only let him be. He is angry with you, and I don't blame him; you did make yourself ridiculous. There, there! I'm not finding fault; I am only putting you in the way of mending matters. Go to your husband, child—go to him frankly, and tell him you know you were wrong, but that you thought no harm at the time, and that you are sorry now. Frank is as well satisfied as I am that you never thought any harm; he never had any doubt of you that way—not a bit."

"If I could only think that!" Katherine began.

"You may be sure of it. He was angry because you made yourself and him ridiculous; and he was quite right. Go to him and talk to him freely, and tell him you know now that you ought to have had more sense, and that you are sorry, and see if he doesn't take you in his arms and kiss you without more ado. Come—go along."

He pushed the young woman before him with genial roughness, and did not leave her until they had reached the library door.

"Now go in, Kitty, and have this over."

"If he won't speak to me—if he is angry?"

"Oh, go in, girl, and try; it will all come right."

Captain Marion gently opened the door, and pushed his daughter in.

Frank was standing with his back to her as she entered. She went softly up to him and put her hand upon his arm. He turned round, not thinking it was she, and looked surprised when he saw her. Then his face contracted into a frown that was sullen and almost fierce in its expression. She was tremulous enough before, but she became more frightened than ever now.

"Dear Frank!" she said. "Won't you forgive me? I was very silly and foolish, but I never meant any more than that. It was all nonsense, and nothing else. You know that, Frank, don't you?"

Her face became contorted like that of a child who is about to burst into tears. For all the contortion she looked very pretty, and there was something peculiarly touching in her fear and supplication.

Trescoe had not been used to see his wife in that mood. He had never known her to supplicate to him before, or to be afraid of him. The novel fact that she was afraid of him brought a rush of pity into his heart. He felt for the moment angry with himself, because he had become thus an object of terror to the poor girl, whose control over him was once so complete. The changing expressions which passed across his face made Katherine believe at first that he was going to reject her appeal altogether. Indeed, he started and moved so suddenly the arm which she had touched, that she shrank back in terror, almost afraid that he was about to fling her away, or to strike her.

But Trescoe put his hand upon her shoulder, and drew her to him, and kissed her. "Never mind, Kitty," he said. "Let us not think any more of this. You were silly, and perhaps I was too cross, and made too much of it. But I never thought badly of you; only I was devilishly annoyed, you know; one must be very much annoyed when he is as fond of a woman as I am of you, and when he thinks she is neglecting him and admiring someone else."

"Oh, don't talk of that, Frank, please don't. I know how foolish I was; but they all admired him, and we all thought he was so good; and, indeed, I don't know anything bad about him now," she added timidly, yet with a certain frankness which pleased him.

"Well, it is all over now, anyhow," he said, "and you and I are friends again, Kitty."

"Papa will be so glad of this," Katherine said.

She was happy again. She had not been happy for months, and at one time she was afraid that all was coming to an end between her and her husband. Now peace was restored, and affection. But it must be said that she never recovered her former rule over Frank, or tried to have it. That is a sort of ascendency which, when once its spell has been broken, can hardly be restored to its old magic. Just as well for her and for him that it was not to be restored. He and she were happy, and she will get on better under the authority of a man than she could when she managed life for herself. She has found that Frank Trescoe is a stronger man than she thought, and he has found in himself the strength which he was too lazy to think of before, and they may be assumed to have bright days before them.

While this scene of reconciliation was going on in one room, Clement Hope had come to Geraldine in another. Their meeting was painfully embarrassed and constrained. Each was afraid of the other. Neither dared to give full liberty of expression, even to the eyes. As for Clement, he was utterly without a key to the mystery.

He assumed that Geraldine had sent for him out of a feeling that it would be unkind not to see him before he went; and her well-meant kindness seemed but cruelty to him.

"You are going away?" said Geraldine.

"Yes, Miss Rowan; I have made up my mind. I think I had better go with Montana at once. It is no use staying here."

"No," Geraldine said; "I suppose not. And when are you coming back?"

"Well, as to that, Miss Rowan, I don't think I am coming back at all."

"Oh, you will surely come back," Geraldine said; "you can't leave England and all your friends for ever."

"My friends can do without me, I fancy; and as for England, she can do without me; and, what is worse, I am afraid I can do without her. I am going in for a new life altogether, and, no—I don't think I shall come back, Miss Rowan, and so I will say good-bye, and I hope you will be very happy, you and Captain Marion."

Geraldine held out her hand.

"You will write to me, won't you?" she said.

"Write to you?" Clement asked, looking at her with eyes of wonder.

"Yes," Geraldine said in an almost imperious tone; "you will write to me. I particularly wish you to write to me."

"And you will answer the letter?"

"If I did not mean to answer the letter I should not ask you to write to me. I want to hear from you, Mr. Hope. Promise me you will write."

"Oh, yes, I will write," Clement said eagerly. "I am only too glad that you care to hear from me."

"I do care to hear from you—you know it."

"Good-bye," said Clement.

"Good-bye," said Geraldine.

One touch of their hands, and the parting was over, and Clement hurried downstairs with a strange impression that a totally unexpected hope was arising before him, and that the world and the future had suddenly, he could not tell how, become different for him from what they were an hour before. He was too confused to be able to analyse his own emotions, but his feeling as he came into the street, after having said good-bye to Geraldine, was not that of mere despair. It was not easy for him to say what had given him any ray of new hope. The very earnestness with which Geraldine had made him promise to write to her might after all have been only another evidence that she

looked on him as her friend, and one who never could be anything more. Yet in her manner, in Captain Marion's manner, Clement thought he read some vague strange encouragement which he hardly dared to admit, and which yet he would not give up. What excuse for any hope could there be? he asked himself in bitter remonstrance with his heart; and still the heart answered that the excuse was found in Geraldine's eyes when he and she parted.

Clement left London that night.

And now the day had come when the steamer was to carry Montana and his fortunes to the new world. It was a busy day in Aquitaine's house. Clement Hope had arrived in the town, and had been laid hands on by Mr. Aquitaine, and carried off to stay with him. Mr. Aquitaine indeed seemed anxious to get as many friends as he could into the house, and to allow Melissa and Montana and himself as little time as possible for reflection of any kind. Young Fanshawe was there too, and Sydney Marion, who had come down to see her old friend Melissa before the long talked-of Continental journey should take place, in which she and Captain Marion and the Trescoes and Geraldine were to begin to enjoy themselves at last. Perhaps, out of all the company gathered together under Aquitaine's roof, Sydney Marion had the best time of it. She was a good deal with young Fanshawe, and Fanshawe was very attentive to her, and evidently began to find in her qualities of attraction which he had not noticed before. It is not very encouraging to a girl's self-love to be sought after and clung to when no other girl is near, but Sydney Marion had been condemned to a sort of second-class part all her life, and she was now growing used to it. She did not in the least blame young Fanshawe or anybody else for looking after a more attractive girl when the more attractive girl was near—she held that to be all fair and natural—and was well content, now that the more attractive girl was not in the way, to receive with a welcome such alms of attention as might fall to her own share. Meanwhile, let us say that she was doing a little injustice both to herself and to Fanshawe. She was a more attractive girl than she thought, and the unlucky fact which we mentioned early in this story, that her style of face was out of fashion, did not impress Fanshawe nearly as much as it would have impressed young men of more distinctly æsthetic tastes. In short, although Sydney did not then know it, young Fanshawe was beginning to see great charms as well as good qualities in her, was finding that he could not be so happy anywhere else as in her society, that he could not be happy when she was away; and probably Sydney Marion is not destined to a spinster's life after all.

Bright and crisp, with its touch of autumn chill on it, rose the day in early October when Melissa was to part from her husband, and he was to cross the Atlantic. She had stipulated that she was to go on board the steamer and see the last of him. She declared that she would not make any sort of a scene; and indeed her manner had been much too subdued of late to give her friends any dread on that score. Her father looked at her that morning with eyes of wonder. Was that his Melissa?—his little petulant, wild, uncontrollable Melissa,—that pale, subdued, and silent girl? Was it happiness that had worked the change, or sorrow?—the happiness of having her idol for a husband, or the sorrow of parting from him? Once Aquitaine could not have believed that either happiness or sorrow could work such a change in such a nature.

Montana had been up very early that morning, and was busy writing letters. One he gave to Mr. Aquitaine. "I wish you would keep that," he said, "for the present, and open it when you hear from me; it only contains some instructions that I should like you to carry out about certain property I hold in trust, as I may say, for England. Don't you remember when I first came to London I made an appeal to the public to assist me? Well, I got a good deal of money, and a great many things of value, chains and watches and jewels and bracelets and such affairs, and I have kept them. I have not touched any of the money, and the other things remain just as they were. Now, a sort of feeling has lately been coming over me that as Englishmen are so much mixed up in this project of mine, the money raised in England ought to be spent for their benefit alone. I feel a sort of scruple that way. I think Clement Hope and you might arrange somehow for this to be done; so in that letter I just explain to you where the things are to be found, and what they are, and what I should like you to do with them. You will understand this better when you have read what I have written, but it is not worth troubling about just now."

"All right," Aquitaine said; "I have got my sealed orders. I will open them when I get a word from you, and not before."

"Not before," said Montana gravely; "that is, of course, unless something should happen which might make it necessary for you to open them without hearing from me, or in case you did not or could not hear from me. We are all mortal, you know, and something might happen."

"Come, don't talk in that way, Montana. Think of poor Melissa."

"I do think of her," Montana said; "and you will find some-

thing about her in that letter, if anything should happen. But I don't think I look a likely person to expect a premature cutting off. I rather fancy most insurance companies would insure my life on moderate terms, even now."

"I dare say they would," said Aquitaine; "I should be very glad if I were chairman of one of them. Your chest measurement would still recommend you to a dragoon regiment."

Montana smiled with what might seem to be the gratified vanity of a man who, conscious that he has passed the prime of life, is pleased to hear that he still has the best attributes of youth—its muscular strength, its exuberant vital power.

"Yes," he said; "I feel a young man still. If I were to judge by my physical sensations, Aquitaine, my impression would be that I am destined to live for ever."

A few hours more, and they were on the deck of the steamer. Melissa was filled with thoughts of the day when, just on such a steamer's deck, and just at such an hour, she saw Montana for the first time. By an odd little coincidence, as she was passing from the gangway to the deck, her foot caught in a rope and she staggered; and Montana put his arm round her and sustained her almost exactly as he had done on that first day. The whole scene was brought to her with a vividness as if it were present; and she felt her old feelings again, and could recall the strange shock of the new sensation and of the conviction which it brought along with it, that her life was changed for ever by that first meeting.

Was she happy now, now that she had got all that her wildest longings could have asked for? No, she was not happy. It was not merely that the husband she adored was about to leave her for a while, though that was trouble enough too. It was the sad conviction, borne in upon her more and more with each new day, that, after all, he was not hers in the true sense, that he was still only her idol and her husband, and not in any sense her lover.

How like and how unlike all was to that day! There were Montana, and her father, and Sydney Marion, but not Geraldine Rowan, nor Katherine Trescoe, nor Frank, her husband. And Clement Hope was there now who had not been there before. Poor Clement Hope! As Melissa thought of him in her patronising way, she felt almost tender towards him, and wondered whether he cared about her any more, and hoped he did not, and could not help observing that he seemed to have grown much more of a man than he was when she used to ridicule him for his too evident admiration.

If Clement had grown very suddenly into a man, Melissa had grown very suddenly into a woman. All the old childishness was gone from her; and in the fulfilment of her uttermost desire she seemed to have come into the possession of all the gravity and all the sadness that manhood and womanhood bring with them.

There were a few hasty words of parting, and directions, and injunctions on both sides, and shaking of hands here and there, and then a bell rang, and the prosaic call to those about to go ashore was shouted along the decks; and Montana kissed his wife, and she found her father helping her down the ladder into the tender, and the tender presently made for the shore, and the vessel went on her seaward way. Melissa slept that night in her old bedroom in her father's house as if she were a girl once more and nothing had happened, and felt with every pulse and breath that nothing was or ever could be again what it had been to her before.

Chapter XXXVIII.

"In the deep bosom of the ocean buried."

A voyage has commonly three stages. There is first the stage of mere confusion and constraint—when no one knows his own place or his neighbour; when everyone finds the others in his way, and feels sure he shall not like them, and the general conviction is that the voyage will be very miserable, and that it will last for ever. Then comes the more satisfactory stage, when the passengers are getting used to the waves, and to their berths, and their neighbours, and the rocking dinner-tables; when friendships are rapidly formed, and flirtations are sweet and easy to be had, and everyone is disposed to make the best of everything in a voyage which still, even to the happiest, presents itself as destined to be long. Then comes the third stage, when it is suddenly discovered that the voyage is nearly over, and people are looking back upon it with a gentle regret as on something already past, and are even anxious to put off the moment which is to take them from the free and happy indolence, the easy friendships, the cheap enjoyments of the deck to the cares of business and the crowd of cities again. Then the mind turns back, even to those early days of confusion and constraint, with a feeling of sweet regretful pleasure, like to that with which, as men advance towards the evening of life, they think of the very struggles and discomforts of its morning hours.

The voyage of Montana and Clement had reached this later

stage. Another day or two would see the steamer in New York Bay. The time had passed very quickly with Clement. It had passed almost too quickly; and he felt his heart throbbing with a positively painful excitement as they approached the shores of that New World in which he was to try for a new career. Montana had been very friendly with him all the way over; had kept aloof from the other passengers, and had spent most of his leisure hours with Clement. The nights were growing a little chilly, and few of the passengers cared to remain long on deck; but Montana and Clement tramped there for hours after the others had gone below. One night they thus walked the deck and talked together, and Montana began contrasting the conditions under which Clement was seeking the New World with those under which he himself had at such an age made a like adventure. His manner was especially encouraging and friendly.

"Everything seemed to be against me, then," he said; "and everything is in your favour now. You ought to feel very happy. I almost envy you your youth and your destiny."

"But you have realised your destiny," Clement answered. "You have made a name; you are a man of the time. I have all the struggle before me; and shall probably fail; at least," he added hastily, "I shall probably fail in what I most would wish to do; and what is the good of anything if a man has not his heart's desire?"

"True enough," Montana said. "Most of us have known that. But I shouldn't think you would fail even in that." He looked keenly into Clement's face for a moment.

"I don't believe in forecasting people's destinies—in the fortune-teller's sense, that is," Montana went on to say, "but I think a man who opens his eyes and watches quietly can tell in advance a good many things. I think I could forecast your destiny easily enough. Shall I do so?"

"I don't know whether I should like to have the curtain raised, even if it could be done. I am afraid it would be something dismal to see, and that if I have any gleam of hope at all it might be put out."

Montana smiled and shook his head. "I don't see the future for you in that light. I can tell you one part of your destiny, I think. I venture to believe that you are destined to return from America soon. Shall I go on?"

"Oh, yes," said Clement. "Go on, by all means. Tell me something pleasant if you can."

"Yes, I think you are destined to come back from America, and to marry Miss Rowan."

Clement started and felt himself grow red, and turned his head seaward.

"I don't see how that prophecy can be fulfilled," he said. "You don't know, perhaps, that Miss Rowan has found a destiny for herself."

Montana shook his head.

"I don't believe she will ever marry Marion, and I do Marion the justice to think that he would never have allowed the girl to throw herself away on him. No; take my word for it, Hope, that is your destiny, and a better destiny you could not have. Settle in America if you will, and found your colony there. I don't promise you much success in that way, but I think you would do well to stay in the States. After all, you will find there is something in living in a place where no man cares what your father was, or your grandfather. It is a silly feeling, perhaps, which makes one object to a society where one man is supposed to be better than another merely because he is a duke. But the feeling is in the nature of some of us; and the cowardly dread of being looked down upon as a person of low birth has made many a man do a mean and shameful act. All things considered, I think you would do well to settle in America. But I don't lay any stress on that. Only I think I have forecast part of your destiny, and the brightest part of it, too."

Then they began to speak of other things; and naturally the talk soon turned on the purpose which each had in view when leaving England. Montana strongly advised Clement to give up all idea of a separate project of his own, and to go in with him in the enterprise which he described as already in hand. Clement was a good deal surprised at the earnestness with which Montana pressed this recommendation, and the stress which he laid upon the fact that Clement's project was still only a scheme on paper, whereas Montana had the lines of his enterprise already well laid down. Assuredly it seemed only reasonable that Clement should give all his energies to the enterprise that was actually in movement. But he was much surprised at the confident firmness with which Montana spoke of all his plans. Clement had often of late had a suspicion growing up in his mind that Montana was really taking no steps towards the carrying out of his scheme. It was not merely Matthew Starr's assertion which put this into Clement's mind. He had felt such a conviction growing in him, without prompting from anyone else. Now, however, it seemed impossible to doubt that Montana must have been silently working hard all the time in London to bring his project to a reality. Montana did not indeed tell Clement

exactly what he had been doing, or describe to him in detail the precise steps he had taken, but he spoke of the project of the new colony as fully arranged for already. He impressed upon Clement that there was nothing to do when they landed in America, but to go straightway to the new commonwealth, and begin at once to lay out its lands and apportion its occupation. Even the population Clement understood to have been in a great measure provided for already. He certainly understood from Montana that there were settlers enough to make the beginning of the new community, who had arranged to be there to meet their leader on his arrival, and go to work with him at once. Clement became much impressed with the practical ability and the quiet organising power of Montana. All the time, then, that he and others believed Montana to have been wasting his time in London, dreaming and visiting, and making speeches, and attending dinner parties, and receiving compliments, it was plain that Montana must have been quietly and systematically working away at the details of his new organisation. Nothing seemed more natural than Montana's eager earnestness as he drew nearer and nearer to the scene of what would probably be the great enterprise of his life. In London he always talked reservedly and coldly of his project. He seemed to put enquiry away—to be unwilling to approach the subject. Perhaps this very fact had given rise to some of the doubts in men's minds as to the reality or the practical existence of the project. But now, on the deck of the steamer approaching the shores of America, Montana seemed as if he could not be too earnest in impressing upon Clement the already accomplished success of the plan he had at heart. Clement thought of this long after, and with wonder. Surely, if any man ever was in earnest, Montana must have been in earnest that solemn night. Surely it was impossible to suppose that Montana all the time did not really believe in the existing reality of his enterprise. When they parted for the night, Clement left his friend with the conviction that if there was in the world a man really eager to meet the coming days, longing to live for the sake of a great enterprise, and confident of his power to make it a reality, that man was Montana.

They went below together.

"Good night," Montana said as they were parting; "I feel inclined to sleep, somehow—an unusual thing with me. I did not sleep much last night. I get more eager for this thing the nearer we come to it. I have been thinking about it all day, and about nothing else hardly. Somehow I feel tired, and I shall indulge myself with a good long sleep. Do you know what I am going to do?—an odd

thing for me?—I am going to sleep as long as ever I can to-morrow morning. I am not going to be called. For once I will give myself a sleeper's holiday, and have it out with nature."

They shook hands warmly, and Montana turned in.

But Clement found before long that he had no inclination for sleep. He had half-undressed, when he suddenly changed his mind, dressed again and went on deck. He wanted to be alone, to think over what he had heard from Montana, and to compose his wild and rapidly growing hopes into something like calmness. He wanted to look the future, so far as he could venture to read it, steadily in the face and see whether he could find any reality in the promises which seemed now to be so unexpectedly and so strangely held out to him. Clement was still of that age when we want the companionship of skies and stars to share our wild hopes with us, or to help us to tone them down. Skies and stars and rushing sea make glorious confidants for a youth in Clement's case; and here he had them all to his heart's content and to himself. It was now very late, and all the other passengers had long gone below. The night had become bright. The moon was shining now, which was not so before. There were some clouds here and there. The sea was smooth and silent. The throbbing of the engines, the rushing of the bows through the water, alone disturbed the majestic stillness. Clement looked from the stern along the track left by the vessel as it passed. He questioned the future, and only began to feel more hopeful. Montana's words had impressed him deeply. Something in his own heart, some memories he could not define, some startled glances of Geraldine's, ratified the hope Montana had tried to give him. These hopes, and the beauty of the night, and the near approach of the end of the voyage, and the prospect of the new career so soon to begin, revived and strengthened him, and he felt just then as if he could not but take a bright look forward and believe that things would come well.

Suddenly it seemed to him that he heard a light plash into the sea, as if something had glided rather than fallen from the steamer's deck into the water. He had seen no one on deck, however, anywhere, except two or three seamen at their duties, who were still there. He might have ceased to think of it, but that, looking out over the water, there seemed to float past him the form of a man. At least, he fancied for a moment that he saw between him and the water a white face, which flashed ghostlike out of the dark waves and then was gone. Clement was sure that someone had fallen overboard, and had been swept by the rush of the water far away to the

stern. He did not lose a moment in acting on the thought. He shouted with all his might, "Man overboard!" and plunged into the steamer's foaming track. The cry was echoed, and in a moment there were hurrying men on the deck, and the passengers who lay below in their berths, or still sat in their state-rooms or in the saloon and talked, were conscious of that strange alarming sensation which comes when on the ocean a steamer suddenly stops in her course. The engines are silent, the screw grinds and churns no more, the waters cease to rush noisily around the bows, and the vessel is motionless. Few sensations are more strange to the inexperienced than the awful stillness of such a moment. The sudden change from speed to motionlessness brings with it ominous suggestions of some danger, some impending calamity. The vessel was admirably ordered, and not many seconds had passed before a boat was lowered, and it made to the assistance of the struggling Clement, already far away in the sea.

Clement was a stout swimmer. In the seaport where he was brought up boys learned what real swimming means. The night was calm. He had keen sight. He had leaped into the sea the very moment he saw what he fancied to be the drowning man. He was borne along by the vessel's track in exactly the same direction. The moon was bright; the sky was clear; but he could see nothing on the surface of the water between him and the dim horizon. When he saw what he believed to be a face rise from the waves, it was just in the moonlight, and he had struck out straight in the right direction, but he could see nothing now—nothing at all. For all the bitter chill of the sea—and how cruelly cold it was!—Clement trod water composedly, and looked all around him. He could see that the steamer had stayed in her course, and he heard commands shouted, and knew that a boat was being launched. In another moment or two he saw the boat rowing towards him, and heard the cheers of the sailors. For a moment he fancied that they had found the man whom Clement still supposed to be in the sea. But in another instant it was clear that they were making only for him—Clement—and were under the impression that he alone was overboard. They redoubled their cheers good-naturedly when they came up with him, and when he scrambled into the boat, and were very noisily glad of his rescue. It took some time before he could impress upon them the fact that he had been in no manner of danger, that he had leapt overboard to save somebody who really was in peril, and whom they were bound to seek and rescue. They one and all treated his story as a mere delusion. The watch was clear that there was only one

man overboard, and if he had jumped overboard under the impression that he was rescuing anybody, he was, they rather seemed to imply, a fool for his pains. Anyhow, no sight or sound of any swimmer in his agony vexed the quiet sea now.

Clement was brought back on board the steamer in rather ignominious plight. He had been dreaming, some of the passengers said. It was hinted that he was fond of composing poetry. Many persons were merely annoyed at having been wakened and disturbed by such a piece of illusion. A hasty examination of the vessel was made, and nobody was found missing; that is to say, all the passengers and crew who happened to be awake were accounted for, but there were several cabins the occupants of which had gone to rest, and locked the doors inside, and it was not thought necessary to waken the sleepers from their dreams. So all went to rest and slept quietly until morning. In the morning some surprise was expressed that Montana did not appear at breakfast—so marked a figure as his was likely to be missed; he did not make his appearance on the deck after breakfast, and at last someone suggested that it would be well to knock at his door and call him. Clement did knock at the door, and no answer came. Then the steward was sent for, and he knocked; and no answer still coming, the door of the room was forced open. Montana was not there, nor had his bed been slept in. His door had been locked, and evidently from the outside, and the key taken. Montana had not been seen by anyone since the night before, and he was not seen again. The steamer reached the quays of Hoboken, opposite New York, without him. All that could be said of him was that he was in the steamer one memorable night, and was not there the next morning.

Early in the morning of the day when Montana was missed a restless girl far away in her North of England home was looking through her window on the waters of the river that rippled below. She could not remain in her bed—in her heart there was a kind of fighting that would not let her sleep. She opened the window and looked out. The dawn was coming up, and the river was just beginning to sparkle to the eastward with the rising rays; it looked peaceful, almost one might say a very type of tranquillity, that smooth flowing river, its surface hardly broken by a ripple.

Melissa might have found assurance for any uneasiness in the sight of that river and that sky. Nothing was there to tell of storm or to suggest danger to those who were on the sea. The girl was made a little more tranquil by the quiet beauty of the water and the sky. Certainly, a quiet morning on an English river is no guarantee for

glassy seas and soft breezes some two thousand miles away on the ocean, but it is the tendency of the human mind to find omens and auguries in everything, to discover encouragement and consolation where there is no real substance for either, and to extract despair from conditions that do not even warrant discouragement. So Melissa was beginning to be contented, and to tell herself again for the hundredth time every night and morning that her husband must be perfectly safe, that he must now be near the shores of America, that he had promised to telegraph to her the very moment of his landing, and that she might count on getting such a message from him within a day or two. Suddenly, however, the sky began to darken to the eastward. It was as if the sun had failed for a moment to break through the mass of clouds. The water blackened, and it seemed to Melissa that a chilling bitter wind fell upon it and scourged it into a sudden roughness. Her agitated mind found terror in the slightest omen of darkness and danger; for a moment it seemed to her that a pale face rose out of the water and looked wistfully at her, and then appeared to float or vanish away along the darkened stream. It was only an instant that this strange illusion lasted, but it struck terror into Melissa's heart.

"He is drowned, I know he is drowned!" she cried aloud. "There has been a wreck, and he is drowned; and I shall never see him any more!"

Melissa's vision was doubtless mere illusion; her alarm may have been the offspring merely of an over-wrought and anxious mind; a sudden terror between dream and dream. But the omen of her disturbed morning was only too truly fulfilled—she never saw her husband more. She had had her highest wish in life realized, and it proved to be only emptiness and shadow; she had lived and loved, and had her love made happy for a brief moment, and then all was at an end.

Had Montana merely fallen overboard in the night and so perished? Had he deliberately put an end to his career? That no one ever can know. Taking all things into consideration, it became the settled conviction of Clement Hope that Montana had drowned himself. All that had passed on the night before his disappearance seemed now to point to such a purpose. The more Clement thought over it, the more he became convinced that Montana's conversation with him on that night was intended to lead Clement into the belief that Montana felt sure of a long and active career, and thus to throw a mystery over his disappearance. When he came to speak of it to Geraldine afterwards, this was her conviction also. It seemed in keeping with all that each of them had known and believed about

Montana that he should bring his career to a close in some manner which would glorify it with all the dignity of mystery. Long after, too, Geraldine told Clement what she believed about Montana and his father. She told him of the strange scene she had witnessed in old Mr. Varlowe's dying room, and the word she had heard Montana speak, and the answer that Mr. Varlowe had given. They two were inclined on the whole to form a lenient judgment of Montana, his self-delusions, his impostures, his theatric life, his belief in his vague and shadowy mission. They did not condemn him wholly. One part genius, one part imposture, one part made up of a self-delusion amounting almost to insanity—such was in the mind of Clement and of Geraldine the composition of Montana's character. When Mr. Aquitaine came to examine the papers left by Montana in the charge of his bankers, he found a recently-made will, which gave the whole of Montana's own property to Melissa. The property was large, and came to her at a time when it could be of no manner of use to her. Aquitaine for long after did not even tell her of the will. In an iron safe belonging to Montana, Aquitaine found heaped up all the watches, bracelets, rings, chains, brooches, and money which had been bestowed in answer to Montana's appeal on the first night when he addressed a London audience. Some of the watches had stopped apparently at the very moment when they were allowed to fall into the picturesque urn provided for the contributions of the generous, and had not been wound ever since. Montana had taken no heed of them; he had allowed all the precious trinkets to remain untouched from that hour. Aquitaine going over them with a sort of melancholy curiosity, and wondering whether it would be possible to restore any of them to their former owners, came on a bracelet which he well knew. It was one of a pair that he had given to Melissa on her birthday. It had been made after a fashion of his own, and it bore her name, and his, and her mother's, curiously interwoven. It was one of the offerings Melissa had made to her new idol that memorable night. Aquitaine took the bracelet out and kept it. "I will give it back to her some time," he said to himself; "but not now—not just now."

Neither in England nor in America could Clement or Aquitaine find evidence to show that Montana had made any preparations whatever for his colonising enterprise. Clement carefully and quietly made search in America, and Aquitaine in England. It became plain to both of them that during all his stay in London Montana had not taken any step whatever towards the realisation of the object which professed to be that of his life. He had written to no one,

directed no one, taken counsel with no one. Evidently the entire scheme was but a cloud, an illusion, something which Montana vaguely meant to attempt, if ever a convenient time should come. Doubtless this had weighed upon Montana's mind of late, and had helped to decide him in the course he took. A few days more, and discovery and exposure would have been certain. Once he touched the shores of America, it would have been impossible any longer to keep up the delusion. Montana had, in his characteristic fashion, allowed the days and weeks and months to go by in London, always saying to himself that he would do something to-morrow or the day after, and doing nothing. As we have said before, and the point is necessary to any understanding of Montana's character, or even any reasonable conjecture that way, Montana was not a man of imagination, but only a dreamer. When action was forced upon him he could rise and act as a man can do who is startled out of a dream, but then his action was only like that of an awakened dreamer, sudden, swift, decided by chance, or impulse, or accident. From his point of view, if he were not to risk a mere ignoble exposure, there was really nothing left for him but some sudden and striking close of his whole career. The curtain had to fall somehow, and it was characteristic of Montana that he should have preferred to bring it down in a way which would leave the close of the drama a mystery.

Melissa bore the news, when it was made known to her, with much greater composure than might have been expected. She persisted in saying that she knew it would be so, that from the morning when she looked out in the dawn she knew that Montana was gone from her for ever. "It could not end happily," she said; "there could be no happiness come out of it for him or for me, and it is better for me as it is. Now I shall have him always with me. Nothing can change him or take him away from me any more."

Mere despair had with her taken the place of fortitude or of Christian resignation. She refused to listen to any words of consolation, and cared nothing for sympathy.

"I have to live," she said, "and I must only put up with it."

To her father she once said with a wan, wild smile, "Don't be afraid that I shall do anything to myself. I had rather live, dear, ever so much. I might find out, if I died—in the other world, you know—that he did not care about me any more; so I'd rather live and keep him always with me here."

And so Montana disappeared. Nothing was ever heard of him again. The common belief, which no one who had reason to think otherwise ever cared to discredit, was that he had merely slipped

over the side of the steamer somehow, and been drowned. To none except to Clement and Geraldine and Aquitaine did it occur to think that the act had been the deliberate and dramatic close of a mysterious career. But among Montana's own special admirers and followers there were many who refused to accept any story which started on the assumption that Montana was gone for ever. Hundreds and thousands of men and women in America and in England still believe that Montana will return; that whether the ocean did close over him or not, their leader and prophet will come back all the same, and be with them once again to redeem them from their hard lot, and bring them into a new bright life of health, and happiness, and freedom. Little organisations, and societies, and branches are still formed now and then in back settlements of London, and Liverpool, and Glasgow, and New York, and Cincinnati, which bear the name of Montana; and many a theory and doctrine is preached in Montana's name which probably never entered into his mind, or could be reconciled with any of his avowed principles. Here and there, then, amongst little knots of devoted followers, he will be remembered; and, indeed, as time goes on, will be transformed in their memory from what he really was to something altogether different, each eidolon differing from each—a new Montana having come up from beneath the ocean in a different form for each different group of devotees. But the world in general will soon forget him. He had his ambition, however. He was the "Comet of a Season," and disappeared like a comet, no one knew whither.

(*The End.*)

PHOTOGRAPHS OF A GALLOPING HORSE.

ABOUT two years ago I heard for the first time of a photographic achievement which seemed to me at the time scarce credible, and which I was presently assured by one of our ablest English photographers was absolutely outside the bounds of possibility,—to wit, the photographic presentation of a galloping horse. Of instantaneous photography, so called, I had of course heard, and I had seen the process in operation. But I knew that the actual exposure in what is called instantaneous photography is not less than a second, even in that arrangement which was called some ten or twelve years ago pistolgraphy. Again, I knew that the sun had been photographed in a period certainly not exceeding the 1,000th part of a second. But the shortness of the exposure in that case was a necessity, instead of involving a difficulty; for the brightness of the solar image is such that an exposure of the tenth or even the hundredth part of a second would suffice to entirely "burn out" the details of the photographic picture. To photograph a galloping horse, however, with distinctness, requires on the one hand an exposure of much less than a second, or even than the tenth or hundredth part of a second; while, on the other hand, the luminosity of the image cannot, under any circumstances, be greater than that which, when ordinary photographs are taken, involves an exposure of several seconds at least.

As to the first point, it is easy to see that an exposure of a second would result in entirely blurring the outlines of the horse's limbs. A galloping horse advances ordinarily at the rate of a mile in less than two minutes. In the photographs of which I had heard, the rate mentioned was a mile in 1m. 40s., or thirty-six miles per hour. Taking the last-named rate, or a mile in 100 seconds, the galloping horse advances one hundredth part of a mile, or nearly eighteen yards, in a second, and therefore, as a horse at rest occupies a width of less than three yards, it is hardly necessary to say the picture obtained from an exposure of one second would be a mere confused

blur. The image obtained in the tenth of a second would be no better, as the blurring would correspond to a width of nearly two yards. In the hundredth part of a second the image would be blurred to a width corresponding to more than half a foot—so that, although the picture of the horse as a whole might be perhaps just recognisable as a horse, the limbs would be confused beyond recognition. To get a picture which should show the limbs of a galloping horse with anything like distinctness, the blurring should not exceed a width corresponding to one inch in the life-size image of a horse. Now, in what precedes I have only taken into account the forward motion of the horse as a whole; but in considering the definition of the limbs, we have to remember that these are not only advancing with the body, but are moved also in relation to the body, and that when the limbs are being thrown forward, this forward motion is added to the advancing motion of the body. Now, the forward motion of the limbs varies in rate, from nothing when the limbs are farthest forward and farthest back, to a maximum somewhere near the middle of their forward sweep. This maximum cannot be less than the advancing motion of the horse, and is probably much greater.[1] As we must add this forward motion to the advancing motion of the horse as a whole, we get for the maximum forward motion of a limb (meaning now the full forward motion, not only the motion relatively to the body) twice the advancing motion of the horse. We have seen that with an exposure of one second the blurring of the body of the horse would have a width corresponding to half a foot in the life-size image of a horse. The blurring of the limbs would vary from nothing to a width corresponding to a foot. That the blurring, then, should nowhere exceed a width corresponding to an inch, the exposure should not exceed the 1,200th part of a second in duration. As a matter of fact, satisfactory pictures were not obtained until the exposure had been reduced to the 2,000th part of a second, and in later pictures the exposure has been reduced to the 5,000th part of a second.

And here, in passing, I may answer an objection which will occur perhaps to many readers. I remember that after mentioning in a lecture at Sydney, New South Wales, the brief exposure of Janssen's

[1] In the case of a carriage, we get in the motion of the wheels what corresponds to the relative motion of the horse's limbs. In this case, we know that the relative forward motion of the top of the wheel, and the relative backward motion of the bottom of the wheel, are each equal to the advancing motion of the carriage, so that the top of the wheel is advancing twice as fast as the carriage, while the bottom of the wheel is momentarily at rest.

solar negatives, I was asked by one of the chief photographers of New South Wales, who had been present, how I could venture to speak of an exposure of the 1,600th part of a second, when no means could possibly be devised for measuring so short a period of time. I was able to reply that not only had Janssen been able in the most satisfactory manner to measure the exposure of his plates to the solar image, but that science had been able to measure periods of time so short as the 100,000th, and even the 200,000th part of a second. Nay, Wheatstone claims, and not without good reason, that, when attempting to determine the duration of a lightning flash, he measured periods very much shorter even than this. It sounds at first hearing altogether incredible, and indeed absurd, that men should pretend to measure by optical and mechanical means (for so has the task been achieved) a period which is a very small fraction of the duration of a luminous impression on the eye. Yet in reality this has been done by taking advantage of the very circumstance which seems at first sight to render it impossible. The method is so ingenious, and at the same time so simple, that it will be well to consider it here as an introduction to the less minute subdivisions of time involved in the processes which form the subject of this essay.

Conceive a rather large disc of ebony, round the edge of which are inlaid radiating lines of silver wire, exceedingly fine. Say, for instance, that there are 1,600 equidistant radiating lines, or in each quadrant 400, so that each centigrade degree (100 to the quadrant) is divided into four parts. If each wire is the hundredth of an inch in thickness, and the disc is one foot in diameter, the black space between the ends of the wires will be one-hundredth and a quarter (of a hundredth) in width. Now, suppose this disc set in rapid rotation, making, for instance, a hundred rotations per second. Then, in the 160,000th part of a second, one of the radiating wires will be carried to the position which, at the beginning of that short period, had been occupied by its next neighbour. But the forward edge of a wire will be carried to the position which had been occupied by the backward (or following) edge in a shorter time still—manifestly in five-ninths of the short period; for the breadth of the black space between the wires is five-ninths of the distance from centre to centre of successive wires. Thus, if the disc is whirling in darkness, and is suddenly lit up by a flash of lightning, and the flash lasts five-ninths of the 160,000th part of a second, or lasts one 288,000th of a second, the disc will appear as if bordered by a continuous ring of silver; for

during that time every part of the edge will have been occupied by lightning-lit silver, and as the eye retains a luminous impression for fully one-tenth of a second, the light from every part of the edge of the disc will appear to form a single image, in which the spokes of wire will not be separately discernible. If the lightning flash lasted half that time, the black spaces would be discernible, but would seem to be but of half their real width, half their width being cut off during the continuance of the flash. If the flash lasted a fourth of the above-mentioned time, only one-fourth of the width of the black space would be cut off, so that its width would appear but three-fourths of what it really was, and so forth for yet shorter periods. But this will suffice to show that Wheatstone could measure by this method, as he claimed, the millionth part of a second. For manifestly the eye could readily detect the diminution of the black spaces by a full fourth of its amount, and this reduction (on our assumptions as to the size of the disc and the rate of its rotation) would be produced if a lightning flash lasted but one 1,152,000th, or less than the millionth part of a second. Thus, when Wheatstone stated, as the result of his experiments, that a lightning flash does not last the millionth part of a second, he was not (as some rashly asserted) announcing over-confidently what could not by any possibility have been established by evidence, but was, in fact, simply asserting what he had satisfactorily proved. Yet, how wonderful it seems at first that science should be able to say, as it did in this case, that a luminous appearance, visible for fully the tenth of a second, lasts in reality less than the 20,000th, or even than the 100,000th, part of that time.[1]

We see, then, that it is not only possible, but an easy matter, to measure periods of time much shorter than the 1,000th or 10,000th part of a second. But it might still seem marvellous, and in fact it is, that science should be able so to arrange matters that in such a minute period of time an image should be taken which shall be clear and well defined in all its details. Yet this has been achieved,

[1] Within a few hours of writing the above lines, I witnessed at the observatory of Dr. Henry Draper, of New York, a very simple experiment illustrating the instantaneous character of the electric spark, and also the intermittence of a luminosity which, as judged by the eye, appears persistent. While the electric discharge was taking place in a series of rapidly following sparks, the hand held steadily in front of the light appeared to be quite steadily illuminated; but if the hand was rapidly fluttered about, a multitude of distinct images of the hand were seen, producing an appearance as of a multiform hand with multitudinous (and ever varying) fingers attached to it,—the explanation being, that the hand was successively visible and invisible, and many successive images were seen in different positions during each tenth of a second of the duration of luminous impressions.

and some of the results of the application of this process have now to be considered.

In the best paintings of horse-races, charges, the hunting-field, and so forth, we have what may be regarded as a conventional view of the horse at full gallop. He is shown with the two fore legs thrown well forward and the two hind legs thrown well back—in the attitude, in fact, which is indicated by the French expression *ventre à terre*, applied to an animal at full gallop. Anyone who has watched a race or a charge of galloping horses will certainly be prepared to affirm that this attitude is one of those which a horse assumes in galloping. It is, of course, to some degree absurd that this one attitude, which is only (even on this assumption) assumed at certain definite instants by the horse at full gallop, should be presented as the only or almost the only attitude recognisable in a group of galloping horses. Still, the idea generally entertained by those who study pictures of the kind is that this attitude is the most characteristic, and the one best suited for delineation. Accordingly, paintings and drawings of galloping horses which present this attitude and no other, are amongst those most admired by the artistic world.

So soon, however, as we test by instantaneous photography the movements of a horse, we find that this admired and presumedly characteristic attitude is not one which really characterises the gallop. Not only is this the case, but the attitude is actually never assumed at all by a horse either in this or in any other gait. And, on the other hand, we find that positions are assumed by the galloping horse which no one would for a moment have supposed possible.

The positions shown in Mr. Muybridge's photographs are eleven, and these include all the movements made in one complete stride. It requires some care to distinguish the movements of the different legs. Let us follow the movements *seriatim*.

The first position of the series is that shown in Fig. 1. Here the horse seems to be balanced on one fore leg, the two hind legs being thrown into the position often shown in drawings of a leaping horse. The other fore leg is thrown back in a position suggestive of rest rather than of the violent action of a galloping horse's limbs. The four legs are numbered so that their subsequent motions may be followed. It must be remembered that this picture does not

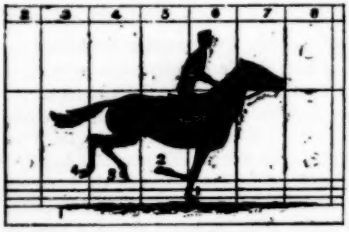

Fig. 1.

belong to the initial series of movements by which a trot or a canter is changed into a gallop. The animal thus photographed was in full gallop all the time. In this position the fore leg marked 1 appears to bear the entire weight of the body, but, in reality, it does not (although the contrary has been maintained). The body has been propelled forwards and slightly upwards somewhat earlier, as will presently appear, and fore foot 1 is in reality scarcely supporting the body at all, but simply adding to the propulsive motion, the body needing for the moment little support.

Fig. 2 shows the horse twenty-seven inches farther forward. (It may be noticed in passing that Fig. 11 shows a position of the body between the positions shown in Fig. 1 and Fig. 2.) The fore leg marked 1 has continued to propel the body forward until this leg had become so aslant (see Fig. 11) that the hoof has to leave the ground, and is thrown back as shown in Fig 2. Fore leg 2 has been carried forward, the hoof rising and the leg becoming more sharply bent. Both hind legs have been thrown forward, but leg 4 more than leg 3, so that the hoofs are rather nearer together than in Fig. 2.

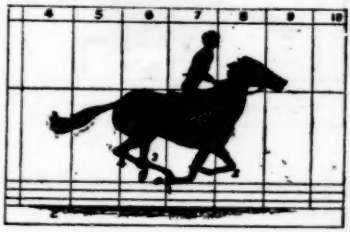

FIG. 2.

In the interval between the positions shown in Figs. 1 and 2 there had been propulsion, though not very forcibly, only one leg touching the ground, and that only during a portion of the time. As the pictures are made at equal distances of 27 inches apart, the time between Fig. 1 and Fig. 2 is to some degree diminished by the additional velocity due to this propulsive motion. On the other hand, as all four limbs are in the air during the interval of time between Figs. 2 and 3, there has not been, in this case, any propulsive action, and the body of the horse has therefore been all the time, though but slightly, losing forward velocity. We note a considerable alteration in the position of all four limbs. Fore leg 1 has been thrown forward so far as the upper part of the limb is concerned, but the lower part of

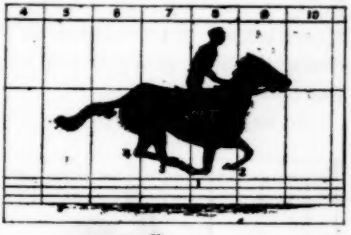

FIG. 3.

the limb has been thrown upward. Fore leg 2 has been thrown forward and is now slightly less bent. Hind leg 3 seems, at first sight, scarcely changed in position; but, in reality, it has been thrown forward and then backward to nearly the position it had when Fig. 2 was taken. Hind leg 4 has been thrown farther forward.

Between Fig. 3 and Fig. 4 the body has been entirely in the air until just before Fig. 4 was taken, when hind leg 3 had just touched the ground. Thus the interval in time, as there had been no propulsive motion, has been rather greater between Figs. 3 and 4 than between Figs. 2 and 3, and greater still than between Figs. 1 and 2. A correspondingly greater change has taken place in the position of the limbs. Fore leg 1 has been curled up under the body, the upper part of the limb being thrown forward. Fore leg 2 has been thrown more markedly forward and partly unbent. Hind leg 3 has been set down by being thrown backward, and hind leg 4 has been thrown forward nearly to the farthest. In this position the body is advancing almost at its slowest—though, of course, it will be understood that in saying this I do not mean to describe the rate of advance as greatly reduced. The body has been only carried forward seven feet four inches from the position it had in Fig. 1, and its rate of advance has scarcely been reduced at all. Nevertheless, such reduction as the rate of advance does undergo during the swift gallop of the horse attains its maximum at about this position.

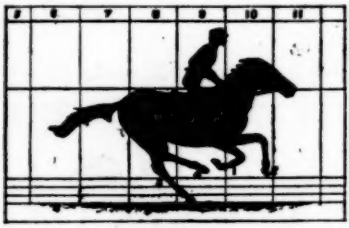

FIG. 4.

In Fig. 4 the fore legs have changed notably in position. Fore leg 1 has been thrown upward (so far as upper half is concerned) and forward. Fore leg 2 has been thrown forward in preparation for the work which this leg will have to do after the hind legs have done theirs. Of the hind legs, No. 3, which in the position of Fig. 4 had just begun the work of propulsion, has driven the body well forward, so that this limb has become nearly upright. The other hind leg seems to be nearly in

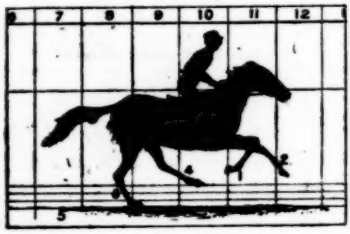

FIG. 5.

the same position as in Fig. 4, but in reality it is now being carried backwards, whereas, in the former position, it was travelling forwards. This leg is the one which is next to take the work of propulsion. Notice that 1 is the *left* fore leg and 2 the right. Between the work of these two legs, both hind legs do their work of propulsion: the left fore leg's work is followed by that of the right hind leg, then the left hind leg does its work and next the right fore leg.

In the position shown in Fig. 6 both hind legs are at work, giving to the body its strongest propulsion both forwards and upwards, but chiefly forwards. Hind leg 3 has nearly done its work; hind leg 4 has little more than begun. Fore leg 1 has been thrown upwards and forwards, slightly unbending. Fore leg 2 has been straightened into a position which no one would imagine to be ever assumed by a horse's leg. However, one can at once see that the attitude is indicative of the energy which is about to be put into the backward stroke given by this fore limb. In considering this picture, and indeed all those in which a hoof touches the ground, it must be borne in mind that the attitude is not one assumed by the horse for any definite period of time, however short. It is difficult to dispossess oneself of the notion that this is the case, and the absurdity of some of the attitudes in our series of pictures arises chiefly from this mistaken conception. Regarding these attitudes as simply *passed* through during the horse's rapid rush forward in swift gallop, they no longer appear so absurd; though, even as thus viewed, there is some difficulty in imagining that attitudes so unlike those which the eye can recognise as a horse gallops past, should be assumed once in each stride. In Fig. 6 we see the horse in that part of his action which is most energetic in the galloping gait. At this stage of his stride, and at this stage only, those two legs are at work in propelling the horse forward which have the greatest propulsive power. Strictly speaking, the stride should be regarded as commenced from this attitude; and I should so have dealt with the series of pictures had it chanced that they represented precisely one stride. Since, however, Fig. 11 shows a position about a foot in advance of that shown in Fig. 1, but about as much behind that shown in Fig. 2, the series only runs by equal intervals from Fig. 1 to Fig. 11, and it was necessary therefore to commence with Fig. 1, though that really belongs to the middle of stride.

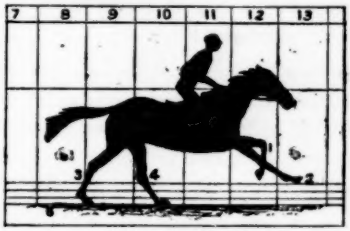

FIG. 6.

In Fig. 7 two feet are shown touching the ground, one a fore foot, the other a hind foot. Leg 2, which in the last figure was preparing for propulsive action, is here fully engaged in it. But the two hind legs have already given a strong propulsive impetus to the body, and hind leg 4 is still urging the body forward. It is only necessary to compare these two legs to see how much more powerful the propulsive action of the hind legs must be than is that of the fore legs. I would venture to predict that if ever an experimental test is applied by which the propulsive action of the fore and hind legs is compared, the former will be found at least three times as effective as the latter. It will be remembered that 2 is the right fore leg and that 4 is the left hind foot. We notice, further, that the gallop is not a symmetrical gait, as the trot is. For in the trot right and left fore legs work in similar ways with left and right hind legs respectively. But we see, from the series of figures illustrating the gallop, that whereas the right fore leg works with the left hind leg, the left fore leg does not work with the right hind leg. Each of these legs—the left fore leg and the right hind leg—does its work alone, except that the right hind leg during a part of its work receives help from the other hind leg, but at no time from either fore leg. Such, at least, is the case illustrated in our series of figures; of course, the gallop can equally be executed when the right and left fore legs do the work which the left and right fore legs are here represented as doing, the hind legs also interchanging their work. In fact, the illustrations would have appeared precisely as they do if the work of the two fore legs, as of the two hind legs, had thus been interchanged.

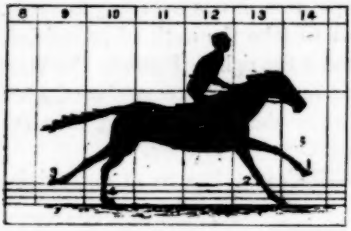

FIG. 7.

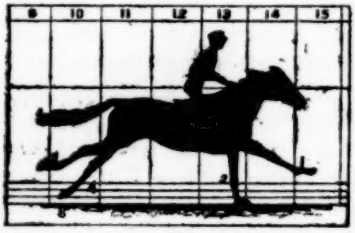

FIG. 8.

In Fig. 8 the two hind legs are both thrown back, and are, for the moment, in a position not very unlike that in which these limbs are commonly represented in pictures of a galloping horse. But the fore limbs are posed as the fore limbs of a horse never were shown in a picture. Fore leg 2 is at work urging the horse forward, or rather it is maintaining and increasing the

forward motion given by the energetic action of the hind legs. Fore leg 1 has been straightened from the position shown in Fig. 7, but it is to be noticed that in the interval between the positions shown in Figs. 7 and 8 this leg has reached its highest motion upward, and is now on its way downward. Notice also that the fore legs are always more or less bent when rising, but that as they are brought downwards to give their stroke, they are straightened, even from the beginning of this downward motion. Compare, for instance, the pose of fore leg 2 in Figs. 5 and 6, and again of fore leg 1 in Figs. 7 and 8. Notice also that each leg remains straight in sweeping round through about a right angle, fore leg 2 from the position of Fig. 6 to that of Fig. 9, and fore leg 1 from the position of Fig. 8 to that of Fig. 11.

In Fig. 9, fore leg 2 is shown doing the last part of its work of propulsion, while fore leg 1 is just about to begin its work. The hind legs are so nearly in the same position in the picture that it is not easy to tell which is which. However, a little consideration will show that the leg whose hock shows highest is, as marked, fore leg 3, or the right. For, notice that in Fig. 3

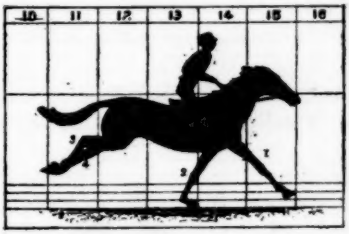

Fig. 9.

the right fore leg (3) has nearly the same position as the left fore leg (4) in Fig. 5. In Fig. 4 and Fig. 6 these legs have respectively nearly the same positions. So have they in Figs. 5 and 7, in Figs. 6 and 8: though here the slight difference in time between the action of the right fore leg in one picture, and the left fore leg in the next picture but one, is shown by the right fore leg being on the ground in Fig. 6, while the left fore leg has just been lifted from the ground in Fig. 8. We infer, then, that the left fore leg in Fig. 9 has nearly the same position as the right fore leg (3) in Fig. 7—in other words, is nearly straight. Therefore, the other or more bent leg in Fig. 9 is the right fore leg (3). We see, in fact, that just as the fore legs begin to straighten just after they begin to descend for their propulsive stroke, so the fore legs continue nearly straight after their propulsive stroke, until just before they reach their greatest height. In Fig. 9, hind leg 4 is travelling backwards and passing hind leg 3, which has just begun to travel forwards, precisely as in Fig. 3 hind leg 4, travelling forwards, is passing hind leg 3 travelling backwards. The vigorous action of fore leg 2, and the vigorous attitude—preparative for

action—of fore leg 1, form very striking characteristics of Fig. 9. Nothing could serve better to show how the fore legs do their work than this picture, and yet nothing could be more unlike the conventional position of the fore legs of a galloping horse in pictures. The hind legs look more as shown in the pictures, yet neither are these as any artist who valued his reputation would care to show them in a painting.

In the next position we see the hind legs thrown into an attitude familiar enough in drawings of galloping and leaping horses. Hind leg 3 has been advanced somewhat from the position it had in Fig. 9. Fore leg 1 has commenced the work of propulsion, while fore leg 2 has completed its work and has already become considerably bent, and the foot is well raised from the ground.

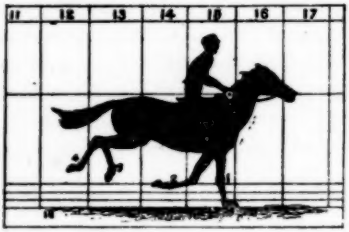

FIG. 10.

Finally, in Fig. 11, we see the end of the stride begun so far as the left fore foot is concerned from the position shown in Fig. 1. As already mentioned, the stride may more properly be regarded as beginning with the action of the hind legs. But we must consider the stride actually photographed. In Fig. 11 we see the fore leg nearly at the end of its work in adding to the forward motion of the body. Fore leg 2 has been carried forward to a position somewhat in advance of that shown in Fig. 1. So also both the hind legs are in advance of the position there shown.

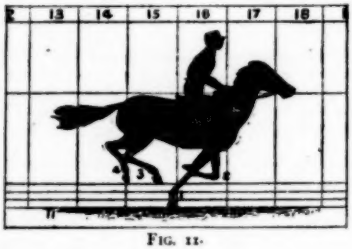

FIG. 11.

Fig. 12 simply shows the horse standing at rest.

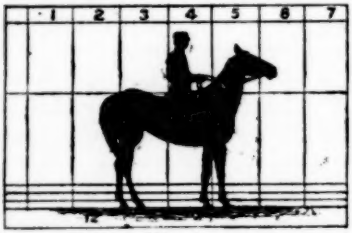

FIG. 12.

In considering this series of pictures separately, we are struck by the absolute want of resemblance between nearly all of them and the attitudes we are in the habit of regarding as belonging to the galloping horse. The second and

third figures alone seem at all natural, though even these would scarcely be regarded as admissible into a painting representing a charge or race. Notice further that these two are the only pictures in which no leg of the horse touches the ground. In all the other nine, at least two of the legs seem absurdly posed; in several, three seem so; while in two, all four legs have a preposterous appearance.

Yet it is found that so soon as the pictures, instead of being studied separately and with steady gaze, are submitted in rapid succession to the eye, each remaining but a fraction of a second in view—in other words, when they are studied in a manner more nearly corresponding to that in which the actual movements of a galloping horse are seen—the views which had appeared separately absurd become merged into a view showing the horse as he actually appears in the gallop. By arranging them uniformly round the outside of a rather large disc, only a small portion of the upper part of which can be seen at a single view, and setting this disc in rapid rotation, so that picture after picture comes into view and remains in view but a moment, we are able to see the horse galloping as in nature, stride succeeding stride; every circumstance of the motion, even to the waving of the tail and mane, being truthfully, and therefore naturally, presented.

Mr. Muybridge himself considers that since these views are severally truthful, however absurd they may appear to those accustomed to study the usual artistic pictures of galloping horses, we should infer that pictures such as these ought to replace the conventional attitudes which have been so long in vogue. Here I must confess that, admirer though I am of his work, I am altogether at issue with him. A picture should represent what we see, and he would be the first to admit that the eye cannot properly be said to see any one of the attitudes he has shown to be really assumed by the galloping horse. He might reply to this that neither can the eye be said to see, nor can it see, any of the attitudes shown by artists, for the simple reason that these attitudes have no real existence in nature. But a picture to be true must show what the eye seems to see. Even in such matters as colouring and shading, the artist has to depart from what nature really presents. In order to produce an appearance of reality, he must modify the colours and the shades until in some cases they are utterly unlike those actually existing. Now, if this is the case where at any rate the objects depicted are at rest, so that one would say the representation, if really correct, should, when duly studied, appear to be truthful, how much more may we expect it to be the case where the object represented is moving so

rapidly that the eye cannot detect the real nature of the attitudes successively assumed! We might, indeed, anticipate that in such a case no drawing could possibly represent the appearance of the moving object. In many cases this is actually so. But in others, as in that of a carriage rapidly advancing, we know that the appearances recognised by the eye can be readily enough represented. Now take such a case as this. At any instant of time the wheel of a rapidly advancing carriage has its spokes in some definite position, and we might draw them in such a position, and regard the wheel when so drawn as correctly represented. But we know that if it were so drawn the carriage would appear to be at rest; and that to convey the idea of rapid motion, the wheel of a carriage must be represented as it really appears to the eye, with the spokes blended together into confused discs. When the wheels are so drawn, and accessories drawn in so as to suggest the idea of rapid motion, as post-boys leaning forward and flourishing their whips, the dust rising around the wheels, and so forth, we obtain a picture which conveys the idea of a rapidly advancing carriage. The mere fact, then, that a galloping horse assumes such attitudes as are shown in our series of figures is no argument in favour of the introduction of such attitudes into a drawing of a race or charge. One might as reasonably represent cannon-balls in mid-air, in a battle scene, as we see in some of the illustrations of Froissart's "Chronicles." Cannon-balls and musket-balls are certainly in the air during a brisk exchange of missiles, but as no one can see them, they have no proper place in a picture.

On the other hand, it is difficult to understand how the conventional attitudes of a galloping horse came to be employed; for they certainly are not seen during a charge or race, though the idea conveyed may be that such attitudes are not only assumed by the galloping horse, but are actually characteristic of his actions. It may perhaps be, that the attitudes approaching those seen in the pictures are retained longer than the others which seem unnatural. Thus the general effect is, we may assume, that conveyed by the pictures. And yet it is strange, if this be so, that the hind legs do not pass through those positions which seem natural at the same time that the fore legs are passing through their natural attitudes. Thus the positions of the hind legs in Figs. 8, 9, 10, and 11 are not unlike those shown in the pictures, but in all these figures the fore legs are in positions which seem altogether unnatural. On the other hand, in Figs. 2, 3, 4, and 5 the fore legs are in natural positions, while the hind legs are in positions more or less unnatural.

(Of course, in using the words natural and unnatural, I refer only to the conventional ideas as to the action of the galloping horse; all the positions of the eleven figures are really natural, though they are unfamiliar to the eye.) So that, in fact, it seems as though the conventional attitudes of a galloping horse were obtained by combining the position of the fore legs in one part of the stride with that of the hind legs in another. Yet, though this seems strange, it is after all akin to the circumstance that in picturing a rapidly rotating wheel we show the spokes in a number of positions which they do not simultaneously occupy. As in the case of the rotating wheel, so in that of the galloping horse, the movements are too quick to be followed by the eye, and so several positions really occupied at different times are combined together into a single impression. Where the movements are slower, so that the eye can recognise the several positions pretty clearly, the features of different positions would not be thus combined. For instance, an artist's pictures of a trotting horse, even when the pace to be represented is very rapid, do not differ much from those obtained by instantaneous photography. Of twelve such photographs obtained by Mr. Muybridge, only two seem to differ—and those not greatly—from such views as might be given in a picture of a trotting match. So, again, the pictures of a walking horse, of a man walking at full speed, and of a man running at moderate speed, all closely resemble such drawings as an artist would make. But in the case of a man running at full speed, and still more in that of a man taking a high leap, the attitudes are such as have never been shown in any picture—such, in fact, as have never been seen, simply because, though all the attitudes are of necessity really assumed, they are assumed for so brief an interval of time, and so rapidly exchanged for others quite unlike them, that the eye is not cognisant even of their momentary existence. We may note also, as another reason why some of the attitudes of a leaping or swiftly running man seem unnatural (and of course the same reasoning applies to a galloping horse), that they are attitudes which cannot be maintained even for a single second, but are only passed through in the course of a certain series of energetic actions: so that the pictures look like ill-drawn representations of impossible attitudes.

The great value of such pictures lies in the evidence which they afford as to the real nature of the movements involved in particular gaits or exercises, as for the horse in the gallop, canter, run, or trot, and for the man in the high leap (running or standing), the long leap, the run, the swift walk, and so forth. They serve to correct some

erroneous ideas as to the nature of such movements, ideas even entertained (in the case of exercises for men) by those who are most skilled in leaping or running. For instance, Mr. Muybridge informed me that the most skilful runners are positive that, in running swiftly, they bring the toes to the ground before the heel; and certainly most runners, if not all, would think so: but the instantaneous pictures show that in rapid running the heel comes first to the ground. This was shown in every case, even where the runner had been told beforehand that the photographs would put to the test his own confidently expressed opinion that he brought the toes to the ground first. In pictures of a very swift runner at full speed, the toes appear thrown ridiculously upwards, just as absurdly as the hoofs of the fore feet of the horse appear in Figs. 6 and 8 of our series. (On consideration, I am inclined to think the evidence on which Mr. Muybridge depends is open to some degree of question. His views show, as I have myself had the opportunity of noting, that the toes are pointed upwards as the foot descends, till at any rate it is quite near to the ground; but so far as I recollect, they do not show that at the last there is not a rapid motion of the forward part of the foot, bringing the toes down before the heel. Note, for instance, how in Fig. 7 the hoof, which had been pointed upwards in the previous position, Fig. 6, has come down to the ground before the fetlock, which in Fig. 8 has reached the ground; and, still more to the purpose, note how in Fig. 9 we see the hoof before reaching the ground already thrown far downward of the position, relatively to the fetlock, which it had had in Fig. 8. Mr. Muybridge, by the way, asserts that all animals bring the heels to the ground, in rapid running, before the toes: this, of course, would relate only to the hind feet, and is not supported by the views of our series, even if the fetlock be regarded as the heel. But in reality the fetlock corresponds to the ball of the foot, not to the heel, the heel corresponding to the horse's hock, which never touches the ground at all, except when the animal rears till he is absolutely upright.)

I should like to see Mr. Muybridge's method applied to a number of other movements, which so far as I know he has not yet tested; in particular, to the movements of a man's body and limbs in rowing, first in heavier boats, then in lapstreaked gigs, then in racing boats: and in steady pulling, as well as in the fiercest spurts.

Mr. Muybridge claims that in his later photographs the exposure, as tested by the distinctness of the outlines, cannot be more than the 5,000th part of a second. If this is really so, it would be possible by this method to secure a picture, though not a sharply defined one,

of a cannon-ball, even at the beginning of its flight. For such a ball travels at a rate of less than 500 yards per second, so that in the 5,000th part of a second it travels but the tenth of a yard, or less than four inches. Even in the 2,000th part of a second a cannon-ball would fly but about nine inches at the beginning of its course, and much less at the close of its first flight, supposing the cannon so inclined that the range would be nearly the maximum.

RICHARD A. PROCTOR.

"*THE RING AND THE BOOK.*"

CERTAIN rare works of literature, like others of art and philosophy, appear too gigantic to have been wholly wrought out each by the one man who we yet know did accomplish it unaided. Such a work reminds us of a great cathedral, which, even if ultimately finished in accordance with the plans of the supreme architect who designed it, could not be completed under his own supervision or during his own lifetime, being too vast and elaborate for fulfilment in a single generation. And as such a colossal work "The Ring and the Book" has always impressed me. And, indeed, without straining comparison, one may pursue with regard to it the suggestion of a great Gothic cathedral. For here truly we find the analogues of the soaring towers and pinnacles, the multitudinous niches with their statues, the innumerable intricate traceries, the gargoyles wildly grotesque; and, within, the many-coloured light through the stained windows with the red and purple of blood predominant, the long pillared echoing aisles, the altar with its piteous crucifix and altar-piece of the Last Judgment, the organ and the choir pealing their *Miserere* and *De Profundis* and *In Excelsis Deo*, the side chapels, the confessionals, the phantastic wood-carvings, the tombs with their effigies sculptured supine; and beneath, yet another chapel, as of death, and the solemn sepulchral crypts. The counterparts of all this and all these, I dare affirm, may veritably be found in this immense and complicate structure, whose foundations are so deep and whose crests are so lofty. Only, as a Gothic cathedral has been termed a petrified forest, we must image this work as a vivified cathedral, thrilling hot swift life through all its "marble nerves:"—

> It interpenetrates my granite mass;
> Through tangled roots and trodden clay doth pass
> Into the utmost leaves and delicatest flowers;
> Upon the winds, among the clouds, 'tis spread;
> It wakes a life in the forgotten dead,—
> They breathe a spirit up from their obscurest bowers.

We have all often read the anecdote of Newton so told as to imply that the discovery of the law of gravitation was owing to the accidental

arrest of his attention by the accidental fall of an apple. But apples have fallen by myriads ever since Eve was tempted to eat of one in Eden; yet we do not learn that any of them ever suggested that law until in the garden at Woolsthorpe one fell into a mind already teeming with meditations to the very verge of the discovery, and prepared to crystallise round *any* appropriate fact that should fall among them. Just so a certain square old yellow Book, a hundred and sixty-seven years old, small quarto size, with crumpled vellum covers, part print, part manuscript—print three-fifths, written supplement the rest—must have passed unsuggestive or unproductive through very many hands, and might have passed through millions more without suggesting anything better than a little romance or a magazine article; but a great Poet one fierce June day (in 1865, as I read) picks it up for a *lira*, eightpence English just, from among the old and new trash of a stall on a step of the Ricardi Palace in the Square of San Lorenzo, Florence; it thus falls into a heart and mind full of learning and knowledge, thought, insight, genius, intense human sympathy, which all leap to crystallise around it in most living crystallisation; and we have as result this stupendous Poem, stupendous far more by quality than by quantity, though numbering over twenty thousand lines; a work destined to rank among the world's masterpieces—"The Ring and the Book."

Mr. Swinburne, in his fine Critical Essay on George Chapman, devotes several pages to the vindication of Browning from the common charge of obscurity; pages not really discursive, for they shed clear light upon the proper main theme. I am loth to mutilate such admirably proportioned eloquence; but as it appears to me no less just than eloquent in its insistence on certain dominant qualities of Browning's genius, I cannot refrain from citing a few of its salient sentences, while commending the whole to the study of the reader; for why put poorly in one's own words what has been already put richly in another's?—

> Now, if there is any great quality more perceptible than another in Mr. Browning's intellect, it is his decisive and incisive faculty of thought, his sureness and intensity of perception, his rapid and trenchant resolution of aim. To charge him with obscurity is about as accurate as to call Lynceus purblind, or complain of the sluggish action of the telegraphic wire. He is something too much the reverse of obscure; he is too brilliant and subtle for the ready reader of a ready writer to follow with any certainty the track of an intelligence which moves with such incessant rapidity, or even to realise with what spider-like swiftness and sagacity his building spirit leaps and lightens to and fro and backward and forward, as it lives along the animated line of its labour, springs from thread to thread, and darts from centre to circumference of the glittering and quivering web

of living thought, woven from the inexhaustible stores of his perception, and kindled from the inexhaustible fire of his imagination. He never thinks but at full speed; and the rate of his thought is to that of another man's as the speed of a railway to that of a waggon, or the speed of a telegraph to that of a railway. It is hopeless to enjoy the charm or to apprehend the gist of his writings except with a mind thoroughly alert, an attention awake at all points, a spirit open and ready to be kindled by the contact of the writer's: . . . . we have but to come with an open and pliant spirit, untired and undisturbed by the work or the idleness of the day, and we cannot but receive a vivid and active pleasure in following the swift and fine radiations, the subtle play and keen vibration of its sleepless fires; and the more steadily we trace their course the more surely do we see that these forked flashes of fancy and changing lights of thought move unerringly around one centre, and strike straight in the end to one point.

Now, if Mr. Swinburne is right, as in my judgment he certainly is, the dominant qualities he has affirmed will naturally be most conspicuous in Browning's greatest work. Let us now go back to the Book :—

> "*Romana Homicidiorum*,"—nay,
> Better translate—"A Roman murder-case:
> Position of the entire criminal cause
> Of Guido Franceschini, nobleman,
> With certain Four the cut-throats in his pay,
> Tried, all five, and found guilty and put to death
> By heading or hanging as befitted ranks,
> At Rome on February Twenty-two,
> Since our salvation Sixteen Ninety-eight:
> Wherein it is disputed if, and when,
> Husbands may kill adulterous wives, yet 'scape
> The customary forfeit."
>
> Word for word,
> So ran the title-page: murder, or else
> Legitimate punishment of the other crime,
> Accounted murder by mistake,—just that
> And no more, in a Latin cramp enough
> When the law had her eloquence to launch,
> But interfilleted with Italian streaks
> When testimony stooped to mother-tongue,—
> That, was this old square yellow book about.

Having secured his prize, the poet at once began reading it, and read on, though his path grew perilous among the piles of straw-work, the multitudinous upholstery and cast clothes of the square—

> Still I read on, from written title-page
> To written index, on, through street and street,
> At the Strozzi, at the Pillar, at the Bridge;
> Till, by the time I stood at home again
> In Casa Guidi, by Felice Church,

Under the doorway where the black begins
With the first stone slab of the staircase cold,
I had mastered the contents, knew the whole truth
Gathered together, bound up in this book.

This was swift mastery, but swifter follows :—

I fused my live soul and that inert stuff,
Before attempting smithcraft, on the night
After the day when—truth thus grasped and gained—
The book was shut and done with and laid by.

He stepped out on the narrow terrace (to live in fame with Casa Guidi Windows—one house with a double immortality!) built over the street and opposite Felice Church, lighted for festival and filled with clear chanting, while the heavens were yet glowing with golden sunset ; and there—

Over the roof o' the lighted church I looked
A bowshot to the street's end, north away
Out of the Roman gate to the Roman road
By the river, till I felt the Apennine.

And there and thence, already on that evening and night of the first day, the inert stuff fused into white heat, bloom-furnaced, in "the inexhaustible fire of his imagination," not then restless, but settled into a most steadfast, intense, irresistible burning, it was given him to see plainly, "in clear dream and solemn vision," all the scenes and actions and personages of the long-buried tragedy. In my narrow range of literature I know not any instance, not in Shakespeare or Shelley, not in Dante or Leopardi, not in Blake undiseased or Browning's own "Saul," more impressive and authentic of rapt prophetical possession and inspiration, the radiant trance whose sight pierces and strains into foresight, than is revealed in the marvellous passage from line 500 to line 660 in the first section, which bears the title of the whole poem. After full study and absorption of this overmastering vision, which was also pre-vision, one is prepared for whatever of astonishing the mass of the work may consist of or contain. Here is the opening of the vision :—

And there would lie Arezzo, the man's town,
The woman's trap and cage and torture-place,
Also the stage where the priest played his part,
A spectacle for angels,—ay, indeed,
There lay Arezzo! Farther then I fared,
Feeling my way on through the hot and dense,
Romeward, until I found the wayside inn
By Castelnuovo's few mean hut-like homes

Huddled together on the hill-foot bleak,
Bare, broken only by that tree or two
Against the sudden bloody splendour poured
Cursewise in his departure by the day
On the low house-roof of that squalid inn
Where they three for the first time and the last,
Husband and wife and priest, met face to face.
Whence I went on again, the end was near,
Step by step, missing none and marking all,
Till Rome itself, the ghastly goal, I reached.
Why, all the while,—how could it otherwise?—
The life in me abolished the death of things,
Deep calling unto deep: as then and there
Acted itself over again once more
The tragic piece. I saw with my own eyes
In Florence as I trod the terrace, breathed
The beauty and the fearfulness of night,
How it had run, this round from Rome to Rome.

For the supposed parents of the young wife Pompilia lived at Rome, whence Guido, having married her for their money, took her and them to his native Arezzo. They, finding how they had been trapped, contrived somehow to escape to Rome, leaving Pompilia to the tender mercies of Guido and his satyr-family.

These I saw,
In recrudescency of baffled hate,
Prepared to wring the uttermost revenge
From body and soul thus left them: all was sure,
Fire laid and cauldron set, the obscene ring traced,
The victim stripped and prostrate: what of God?
The cleaving of a cloud, a cry, a crash,
Quenched lay their cauldron, cowered i' the dust the crew,
As in a glory of armour like St. George,
Out again sprang the young good beauteous priest,
Bearing away the lady in his arms,
Saved for a splendid minute and no more.

The good young priest was Caponsacchi; Pompilia got refuge with her putative parents, Pietro and Violante, in a solitary villa in a lone garden quarter; eight months afterwards, at the new year, Guido and his four cut-throats killed all three, "aged, they, seventy each, and she seventeen," preserving only her two-weeks-old infant, who might bring their property into Guido's hands. The murderers were hotly pressed and captured that same night, tried, and condemned; Guido, having taken minor orders many enough, claimed privilege of clergy, and appealed to the Pope, the good Pope Innocent XII.—

Innocent by name
And nature too, and eighty-six years old,

Antonio Pignatelli of Naples, Pope
Who had trod many lands, known many deeds,
Probed many hearts, beginning with his own,
And now was far in readiness for God.

He, having mastered the whole case, confirmed the judgment, and with his own hand ordered execution on the morrow, Saturday, February 22, 1698. But let the poet himself relate the catastrophes as revealed to him in the vision :—

But through the blackness I saw Rome again,
And where a solitary villa stood
In a lone garden quarter: it was eve,
The second of the year, and oh so cold!
Ever and anon there flittered through the air
A snowflake, and a scanty couch of snow
Crusted the grass-walk and the garden-mould.
All was grave, silent, sinster,—when, ha?
Glimmeringly did a pack of were-wolves pad
The snow, those flames were Guido's eyes in front,
And all five found and footed it, the track,
To where a threshold-streak of warmth and light
Betrayed the villa door with life inside,
While an inch outside were those blood-bright eyes,
And black lips wrinkling o'er the flash of teeth,
And tongues that lolled—oh God, that madest man!
They parleyed in their language. Then one whined—
That was the policy and master-stroke—
Deep in his throat whispered what seemed a name—
"Open to Caponsacchi!" Guido cried:
"Gabriel!" cried Lucifer at Eden-gate.
Wide as a heart, opened the door at once,
Showing the joyous couple, and their child
The two-weeks' mother, to the wolves, the wolves
To them. Close eyes! And when the corpses lay
Stark-stretched, and those the wolves, their wolf-work done,
Were safe embosomed by the night again,
I knew a necessary change in things;
As when the worst watch of the night gives way,
And there comes duly, to take cognisance,
The scrutinising eye-point of some star—
And who despairs of a new daybreak now?
Lo, the first ray protruded on those five!
It reached them, and each felon writhed transfixed.
Awhile they palpitated on the spear
Motionless over Tophet: stand or fall?
"I say, the spear should fall—should stand, I say!"
Cried the world come to judgment, granting grace
Or dealing doom according to world's wont,
Those world's-bystanders grouped on Rome's cross-road
At prick and summons of the primal curse

Which bids man love as well as make a lie.
There prattled they, discoursed the right and wrong,
Turned wrong to right, proved wolves sheep and sheep wolves,
So that you scarce distinguished fell from fleece;
Till out spoke a great guardian of the fold,
Stood up, put forth his hand that held the crook,
And motioned that the arrested point decline:
Horribly off, the wriggling dead-weight reeled,
Rushed to the bottom and lay ruined there.

But, the truth being thus grasped and gained—grasped as by an eagle's talons, gained as by an eagle's swoop—the whole drama clearly revealed to him on the very night of the day which brought him the book, the poet did not at once set his hand to the work of unfolding it:—

Far from beginning with you London folk,
I took my book to Rome first, tried truth's power
On likely people. "Have you met such names?
Is a tradition extant of such facts?
Your law-courts stand, your records frown a-row:
What if I rove and rummage?"—"Why, you'll waste
Your pains and end as wise as you began!"
Every one snickered: "names and facts thus old
Are newer much than Europe news we find
Down in to-day's *Diario*. Records, quotha?
Why the French burned them, what else do the French?
The rap-and-rending nation!"

He likewise, as he tells us toward the end of the work, searched in vain for any record of the subsequent fate of Pompilia's infant, Gaetano, who, six months after the execution, was decreed heir to his father Guido and to the putative maternal grandparents, and put under the guardianship of one Domenicho Tighetti, chosen by Pompilia herself ere she died of her wounds; and by the same decree her fame was thoroughly established in law.

Not till he came to London did Browning take pen in hand; with Italy as clear in the eye of his mind as if present to his bodily eyes: well may Mr. Swinburne note "the inexhaustible stores of his perception" with "the inexhaustible fire of his imagination." As we read in the opening section,—

The Book! I turn its medicinable leaves
In London now till, as in Florence erst,
A spirit laughs and leaps through every limb,
And lights my eye, and lifts me by the hair,
Letting me have my will again with these
—How title I the dead alive once more?

And yet, when he has nearly finished the labour which he begins with such buoyant consciousness of strength,—

> Swift as a spirit hastening to his task
> Of glory and of good,—

when, in his own words, the Ring is all but round and done,—he can address the Book as "my four-years' intimate." This immense work, charged and surcharged with learning, knowledge, ever-active subtle intellect, ever-vital passion whether of sympathy or antipathy, ever-realising imagination, all thought out and wrought out in only four years!—the fact appears almost incredible to one whose mind moves at about the common sluggish rate. This poem, which, when I first studied it, grew beyond me and above me more and more with the profoundly impressive suggestion, still overawing, of a vast Gothic cathedral no single generation could accomplish; which, at the most grudging estimate, is an achievement whereon, "itself by itself solely," even a mighty artist could be content to challenge the ages, secure of a noble fame; this, I found on nearing the end, had been all reared in such a small section of the architect's life. The unpromising seed of an old yellow eightpenny book chanced to fall into the right rich soil, into the one mind and heart in the world most proper to develop it to the uttermost, and in four brief years it had grown prodigiously into this vivified cathedral, this immense perennial forest, abounding and superabounding with innumerably manifold life.

Pondering this, we can better appreciate one sentence I have quoted from Mr. Swinburne: "He never thinks but at full speed; and the rate of his thought is to that of another man's as the speed of a railway to that of a waggon, or the speed of a telegraph to that of a railway." And it should be noted that these analogies, like all that are genuine, imply more truths than the naked terms express; imply more than the mere statements of comparative rates of mental speed. In ordinary cases we are apt to judge, and judge correctly, that tongue or pen runs the more swiftly the less weight it carries; and our common phrases of "gift of the gab" or "gabble," "itch of scribbling" or "scrawling," mark our contempt for such worse than worthless fluency. But there are supereminent commanding exceptions. The railway train not only runs ten times faster than the waggon, but also carries more than ten times the weight; the telegraph is not only incomparably swifter than the railway, but also incomparably more subtile and pregnant with intellect and emotion; and thus it is with certain men of superlative genius in comparison, first, with us

common plodders; and, secondly, with men of genius, lofty indeed, but not supreme. Their intellects are as the eyes of Friedrich pictured by Carlyle: "Such a pair of eyes as no man or lynx, or lion of that century bore elsewhere, according to all the testimony we have.[1] . . . . Most excellent, potent, brilliant eyes, swift-darting as the stars, steadfast as the sun; grey, we said, of the azure-grey colour; large enough, not of glaring size; the habitual expression of them vigilance and penetrating sense, rapidity resting on depth." Or, as Heine measures their swiftness in the instance of Napoleon: "The great seven-league-boot thoughts wherewith the genius of the Emperor invisibly overstrode the world; and I believe that any one of these thoughts would have given a German author ample material for writing his whole life long."

Having thus at the very opening let us fully into the secrets of the book, exposed the plot of the tragedy, portrayed the leading personages, sketched the course of the trial and appeal, and even re-affirmed emphatically on his own part the final judgment of the Pope; having, in brief, deliberately sacrificed all that he might have gained by a slowly evolved narrative, the interest of expectancy, surprise, suspense, doubt, fear, terror: what is left for the poet to tell us in the remaining twenty thousand lines? do we not already know the whole drama? Confident in his unparalleled resources, Browning at once proceeds to make us aware how he just begins where an ordinary poet would end. In the second half of the first section he lays before us the complete plan, copious in details, of the structure he is about to erect. He has already told us the story? Well, he simply purposes to tell it over again no fewer than ten times, from as many different points of view, by as many different types or persons less one—for Guido speaks twice, in hope before the appeal, in reckless desperation on the night before his execution. A work immeasurably difficult, yet most triumphantly achieved. The interest is to be purely psychological, but of psychology living, not dead; as with Balzac, the analysis by its unrelenting intensity and subtlety, sustained and impelled by an imagination no less intense, develops into vital synthesis; in each of the ten following sections Browning,

[1] But mark, among others, Scott on Burns: "I think his countenance was more massive than it looks in any of the portraits. . . . There was a strong expression of sense and shrewdness in all his lineaments; the eye alone, I think, indicated the poetical character and temperament. It was large and of a dark cast, and glowed (I say literally *glowed*) when he spoke with feeling or interest. I never saw such another eye in a human head, though I have seen the most distinguished men in my time." Burns, though born forty-seven years after Friedrich, overlived him only about ten.

having penetrated to the inmost soul of his creature, from that centre commands both soul and body to his service in complete self-revelation; so that we have ten monodramas, to use Mr. Swinburne's term, all on the same subject, but varying infinitely by the variance in the characters and circumstances of the speakers.

In the dedication of "Sordello," written twenty-five years after the poem itself, Browning says, "The historical decoration was purposely of no more importance than a background requires; and my stress lay on the incidents in the development of a soul; little else is worth study." And at the end of this Ring and Book he writes,—

> So did this old woe fade from memory,
> Till after, in the fulness of the days,
> I needs must find an ember yet unquenched,
> And, breathing, blow the spark to flame. It lives,
> If precious be the soul of man to man.

It lives; and is likely to live as long as any masterwork of our generation.

First we are to hear how Half-Rome, with a typical worthy for its mouthpiece, found for Guido much excuse. Then how to the other Half-Rome, Pompilia seemed a saint and martyr both. Then—

> Hear a fresh speaker!—neither this nor that
> Half-Rome aforesaid; something bred of both:
> One and one breed the inevitable three.
> Such is the personage harangues you next;
> The elaborated product, *tertium quid:*
> Rome's first commotion in subsidence gives
> The curd o' the cream, flower o' the wheat, as it were,
> And finer sense o' the city . . .
> . . . . . .
> What the superior social section thinks,
> In person of some man of quality.

These choric representatives are no mere abstract voices; they and all their appropriate surroundings are realised, embodied, drawn and coloured with the like precision and clearness, the like fulness of characteristic detail, as the real persons and scenes of the drama. These actors follow; first Count Guido before the governor and judges, doing his best man's service for himself, in the guise of frank confession, wrung from him by—

> His limbs' late taste of what was called the cord,
> Or Vigil-torture more facetiously.

Caponsacchi comes next:—

> Man and priest—could you comprehend the coil!—
> In days when that was rife which now is rare.
> . . . . . .
> Then a soul sighs its lowest and its last
> After the loud ones,—so much breath remains
> Unused by the four-days'-dying; for she lived
> Thus long, miraculously long, 'twas thought,
> Just that Pompilia might defend herself.
> . . . . . .
> How she endeavoured to explain her life.
>
> Then since a Trial ensued, a touch o' the same
> To sober us, flustered with frothy talk,
> And teach our common sense its helplessness.
> For why deal simply with divining-rod,
> Scrape where we fancy secret sources flow,
> And ignore law, the recognised machine,
> Elaborate display of pipe and wheel
> Framed to unchoak, pump up and pour apace
> Truth in a flowery foam shall wash the world?
> The patent truth-extracting process,—ha?
> Let us make all that mystery turn one wheel,
> Give you a single grind of law at least!
> One orator of two on either side,
> Shall teach us the puissance of the tongue—
> That is o' the pen which simulated tongue—
> On paper.

For the pleadings were all in writing; fortunately for the poet and ourselves, as they were thus preserved entire in the yellow book. So we next read—

> How Don Giacinto of the Arcangeli,
> Called Procurator of the Poor at Rome,
> Now advocate for Guido and his mates,—
> . . . . . .
> How he turns, twists, and tries the oily thing
> Shall be—first speech for Guido 'gainst the Fisc.

And then—

> Giovambattista o' the Battini, Fisc,
> Pompilia's patron by the chance of the hour,
> To-morrow her persecutor,—composite, he,
> As becomes who must meet such various calls—
> . . . . . .
> How the Fisc vindicates Pompilia's fame.

Then we have the manner of the judgment of the Pope on the appeal:—

> Then must speak Guido yet a second time,
> Satan's old saw being apt here—skin for skin,

All that a man hath will he give for life.
While life was graspable and gainable, free
To bird-like buzz her wings round Guido's brow,
Not much truth stiffened out the web of words
He wove to catch her: when away she flew
And death came, death's breath rivelled up the lies,
Left bare the metal thread, the fibre fine
Of truth i' the spinning: the true words come last.
How Guido, to another purpose quite,
Speaks and despairs, the last night of his life,
In that New Prison by Castle Angelo
At the bridge-foot: the same man, another voice.

. . . . . .

The tiger-cat screams now, that whined before,
That pried and tried and trod so gingerly,
Till in its silkiness the trap-teeth join;
Then you know how the bristling fury foams.

The closing section, called "The Book and the Ring," is an epilogue corresponding to the prologue of "The Ring and the Book;" each concluding with an impassioned apostrophe to the poet's Lyric Love, half angel and half bird, buried there in Florence some years before.

As I have said already, these iterations and reiterations of the same terrible story, told by so many typical and historical personages as beheld from so many standpoints, are the very reverse of monotonous; each new relation tends to deepen and expand the impression left by all that preceded it. The persistent repetition is as that of the smith's hammer-strokes welding the red-hot iron into shape; or rather as that of the principal theme in a great Beethoven fugue, growing ever more and more potent and predominant as its vast capabilities are more and more developed through countless intricate variations and transmutations of time and key and structure and accompaniment. Only, to adequately evolve these capabilities, we must have the consummate master; an imperial genius wielding unlimited resources; an insuppressible irresistible fire fed with inexhaustible fuel. I know of but one other living English poet to whom we can turn for the like supreme analytic synthesis, the patient analysis of a most subtle and unappeasable intellect, the organic synthesis of a most vivid and dramatic imagination; which the better critics at length publicly recognised in the "Egoist," after almost ignoring or wholly underrating them in the "Modern Love," the "Ordeal of Richard Feverel," the "Emilia in England," the "Adventures of Harry Richmond," and other great original works of George Meredith.

Of course, I have no intention of reviewing in detail the several

sections of this vast and multiplex achievement; on which as many commentaries might be written, and I humbly opine to somewhat better purpose, as the Germans have lavished upon Goethe's "Faust." Our professional judges have not been slow to acknowledge the chivalrous splendour of the Caponsacchi and the exquisite pathetic beauty of the Pompilia. Indeed, one may remark of Browning and his Pompilia, as of Dante and his Beatrice, that whenever she is brought in, however austere or terrible or vile the surroundings, immediately an ineffable sweetness, a divine tenderness, suffuses and thrills the verse. The marvellous power and insight of the two Guido sections have been equally acknowledged. The excellent critic of the *Westminster Review* gave his verdict against the couple devoted to the lawyers; "the malt is the best in England, but the beer is bad." In this I cannot concur. To me they represent the grinning gargoyles and grotesque carvings of the Gothic cathedral; the "noble grotesque" of Ruskin, the sport of a strong and earnest, not the serious business of a weak and frivolous mind. In the passage from which I have already quoted, Mr. Swinburne, referring to such pieces as the two Guidos, writes, "This work of exposition by soliloquy and apology by analysis can only be accomplished or undertaken by the genius of a great special pleader, able to fling himself with all his heart and all his brain, with all the force of his intellect and all the strength of his imagination, into the assumed part of his client; to concentrate on the cause in hand his whole power of illustration and illumination, and bring to bear upon one point at once all the rays of his thought in one focus." But what infinite contempt, genial and jolly in the first case, acrid in the other, Browning pours out upon these professional hireling special pleaders! His own object in such pieces as "Bishop Blougram's Apology," "Mr. Sludge, 'the Medium,'" the "Prince of Hohenstiel-Schwangau," is by no means to prove black white and white black, to make the worse appear the better reason, but to bring a seeming monster and perplexing anomaly under the common laws of nature, by showing how it has grown to be what it is, and how it can with more or less of self-illusion reconcile itself to itself. The one great section to which I think less than justice has been done is that of the Pope, with its awful prelude,—

> Ere I confirm or quash the Trial here
> Of Guido Franceschini and his friends,
> Read,—how there was a ghastly Trial once
> Of a dead man by a live man, and both, Popes:
> Thus—in the antique penman's very phrase.

I know nothing that surpasses the wisdom, the true saintliness, the

invincible firmness of the great good old Pope in this decisive monologue.

An author whom we should love for that sole sentence, wrote of his wife, "To love her was a liberal education." It would be scarcely rash to say the like of this one greatest work of our poet, who has wrought so much else that is only less great.

JAMES THOMSON.

THE POLITY OF A PRIMROSE.

FEW subjects, if any, are better calculated to awaken a lively interest in the investigation of natural laws and the phenomena of life at large, than the study of those processes of development whereby the races of animals and plants retain their hold upon the world, and maintain a continuous and unbroken round and cycle of existence. In such studies, more than in any others, we seem to gain near glimpses of Nature's ways and methods in fashioning the varied universe of living beings; whilst the lessons such topics are well calculated to enforce respecting the order of nature as a whole, form not the least important result of these investigations. The study of even the most commonplace object may, under the newer phases of research, be made to yield an amount of "sweetness and light" for which we might be wholly unprepared. The day of the Peter Bells, and of uninquiring moods and tenses, if not altogether a thing of the past, is happily already in its twilight stage. The schoolboy, with a primer of botany in hand, understands things at which the previous generation simply wondered. And even if the results of botanical study may occasionally be expressed by the hackneyed Wordsworthian phrase of "thoughts beyond tears," the modern student of plant-life has ample reason to congratulate himself on having attained the mastery of many ideas, which in past years were included under the poetic category of "expressive silence." The primrose still grows by the "river's brim," in truth, but it is no longer merely a yellow primrose. On the contrary, the flower is in greater part understood, the mechanism of its life is well-nigh completely within our mental grasp; and, best of all, its study has led in the past, as it leads even now, to the comprehension of wider ideas of nature, and more extensive views of plant life, than those which formerly met the gaze of the wayfarer in scientific pastures. The appreciation of what is involved in part of the life-history of a primrose may thus serve as a starting-point for more extensive research into the phenomena of plant-fertilisation at large; and this latter topic, in its turn, falls naturally into its proper niche in teaching us plain lessons respecting the manner in which the wide domain of life is regulated and governed.

By the "fertilisation" of a plant is meant to be indicated those actions or processes in virtue of which those little bodies or "ovules" developed in the seed-vessel (Fig. 1, *p*) become "seeds,"

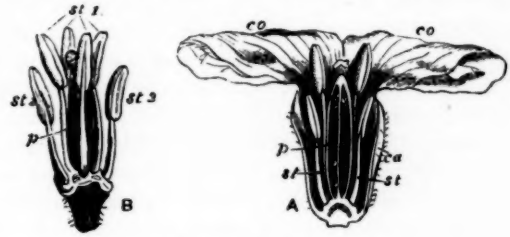

FIG. 1 (A). WALLFLOWER.

and through which they are fitted to develop into new plants. The unfertilised ovule is incapable of producing a new plant.

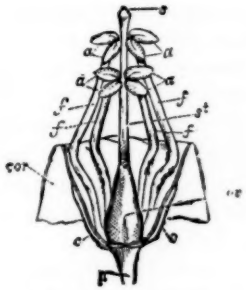

FIG. 1 (B). FOXGLOVE.

FIG. 1 (C). SNAPDRAGON.

When set in the ground it would simply decay as if it were a leaf or other detached and dead portion of the plant-economy. When, on the contrary, it is duly fertilised, the ovule, becoming the "seed," has become possessed of the powers and properties in virtue of which it is capable of evolving the form of the parent-plant from which it was derived. So much for the very necessary botanical distinction between "ovule" and "seed." The process of fertilisation is thus seen to be that on which the continuance of plant-existence depends. More closely regarded, it is known to be that which is capable under certain conditions of giving origin to new races or varieties of the plant-species. When the horticulturist, taking the pollen from one species or variety of plant, applies this fertilising matter to the ovules

of another variety or species, the characters of the two different races are combined and united in the "hybrid" progeny. Our gardens and conservatories—and, as we shall strive to show hereafter, the natural plant-creation at large—have benefited immensely in beauty from a knowledge of the changes in colour, form, and size, which this "cross-fertilisation" may produce. For instance, the finest of our rhododendrons are crosses in which the characters of Indian and American species have been thus blended. The union of the common heartsease with a large-flowered foreign pansy, has produced a new stock in which the excellencies of both species are found. The pelargoniums of our conservatories represent hybrid stocks and varieties, which cross-fertilisation and cultivation have together produced from the small-petaled species of South Africa. Such results, among countless others, would seem to suggest that beneath the subject of cross-fertilisation, or even underlying that of ordinary fertilisation, there lies hid a mine of knowledge respecting the causes which have wrought out the existing variety of plant-life. And for the plain and unfettered understanding of the subject in its less technical phases, or to fix the foundations of knowledge respecting an interesting field of natural-history study, no better subject could be selected than the history of even the commonest flower—such as a primrose. Rightly comprehending what is included in the phases of primrose-life, we may hope successfully to read some of the more abstruse problems presented by the wider aspects of plant existence at large. "The ruthe primrose that forsaken dies," and the "cowslips wan that hang the pensive head," afford us delight even when we are living in all the simplicity of botanical ignorance. It is not too much to say that their systematic study may lead to the higher delights and more cultured joys included in the knowledge of some phases of natural law and in an understanding of the hows and whys of living nature.

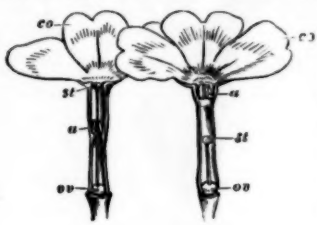

FIG. 2. PRIMROSES.

The elementary botany of a primrose is a matter of few words. Like every other perfect flower, it consists of four parts or circles of organs placed one within the other. Outside, we perceive the circle of fine green leaves, which we name the *calyx*, each green leaf of this organ being named a *sepal*. In the primrose, the sepals are united, although in many other flowers, (*e.g.*, buttercup and wall-flower) (Fig. 1, *ca*), we should find them free and separate. The calyx of all flowers is, for the

most part, coloured green, its obvious use being to form a protective envelope for the other organs of the flower. Within the calyx, we descry the *corolla* (Fig. 2, *co*). This is the circle of *petals* or leaves which, *par excellence*, we call the "flower," because it constitutes in the vast majority of flowers the bright and showy portion thereof. A flower might botanically or physiologically be perfect enough minus its corolla; although the eye, missing the bright petals, would be apt to regard such a plant as wanting the first and chiefest element of the blossom. The common nettle, for instance, appears to possess no "flowers" in the popular and accustomed sense of the term; but when we examine the plant, we readily discover that it possesses parts corresponding to the flowers (Fig. 3) of other plants. In the greater nettle, the flowers of one plant are essentially different (in that they possess "stamens" alone)

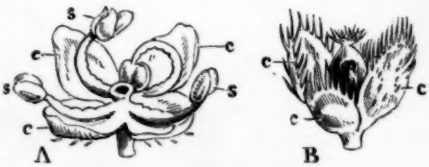

FIG. 3. NETTLE-FLOWERS.

FIG. 4 (A). FEMALE OR PISTILLATE FLOWERS OF WILLOW.

FIG. 4 (B). MALE OR STAMINATE FLOWERS OF WILLOW.

from those of another plant (which possess "pistils" only). But in the lesser nettle, or in the oak (Fig. 5, A, B), these distinct flowers are found on one and the same plant. No vestige of colour appears in either, however; and when we study the flowers in question, we find that a corolla is wanting, although a calyx is present. Again, in the willow, which, like the greater nettle, has its stamens and pistils

(Fig. 4, A, B) on different plants, there appears to be no "flower" in the ordinary sense of the term; and the calyx as well as the corolla is found to be wanting in these trees.

FIG. 5 (A). MALE OR STAMINATE FLOWERS OF OAK.

The *stamens*, just mentioned, form the third set of organs proper to the perfect flower. Looking at a buttercup, or a tulip, or a wall-flower (Fig. 1, *st*), we readily see the stamens. They exist as stalked organs (Fig. 6, *ss*), each consisting of a stalk or *filament* (Figs. 7, 8, *st*), and a head called the *anther* (*a*). The head is hollow and contains the fine yellow dust termed *pollen*, which, at the time of ripening, is usually found scattered conspicuously about the interior of most flowers. The fourth and central set of organs found in the flower constitute the *pistil* (Fig. 9) or seed-producing structure. This organ is composed of one or more parts called *carpels*. Each carpel consists in turn of a lower distended part called the *ovary* (Fig 9, *ov*), within which the ovules are produced; of a neck or filament, the *style* (*st*); and of a head borne on style (*sg*), and named the *stigma*. The style or stigma may be absent, but in the great majority of flowers both parts are present, the ovary being, however, the essential part of the pistil. In the "head" of a poppy, for instance, there is no style; the bulk of the "head" consisting of the ovary, containing its numerous seeds, and the flat cap or lid re pre-

FIG. 5 (B). PISTILLATE FLOWERS OF OAK.

senting the "stigma" of the poppy-pistil. As a final observation concerning the parts of the flower, it may be noted that the separate

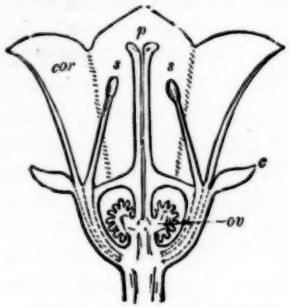

FIG. 6 (A). PARTS OF A FLOWER (CAMPANULA).

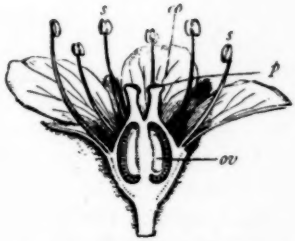

FIG. 6 (B). FLOWER OF SAXIFRAGE IN SECTUM.

pieces, or "carpels," of which a pistil is composed, may either be free and distinct, or closely united and adherent to each other; whilst a second fact of importance in the general description of

FIG. 7. STAMENS OF IRIS.

FIG. 8. STAMEN OF AMARYLLIS.

FIG. 9. PISTIL OF CHINESE PRIMROSE.

flower structure, consists in the declaration that the ripe and mature pistil is the *fruit* in botanical parlance. True, there may, as in the strawberry (Fig. 10), be found united to the ripe pistil certain other parts which constitute the edible and desirable portion of the plant. The true pistil in the strawberry consists of the little yellow carpels, (Fig. 10, *f*), usually called "seeds," which are imbedded in the

fleshy mass of the fruit. But the æsthetics of taste must be neglected in the strict descriptions of science, and that alone is the "fruit," in the eyes of the botanist, which is formed by the ripened pistil, or central organ of the flower.

Fig. 10. Strawberry.

All parts of the flower, it must be observed, are not of equal value in the eyes of the botanist. Those organs—stamens and pistil—which produce and elaborate the seed, are physiologically more important than the circlets or whorls of leaves which, in the form of calyx and corolla, surround and protect them. Yet the latter organs play their own part in the production of seeds, and in some cases serve as the actual means whereby special modes of fertilisation are primarily induced and carried out. As the sequel may show, indeed, the calyx and corolla —which in previous years were deemed mere "floral envelopes," being credited, as such, with a merely protective function—have largely risen in importance in the estimation of the botanical world; since on the form, colour, size, &c., of the corolla especially, largely depend the working of those mutual relations which have been formed between the insect-world on the one hand, and the world of flowers on the other. Peculiarity of a corolla implies, botanically, as a rule, peculiarity of fertilisation; and the importance of the blossom becomes plainly apparent to us when we discover that in place of the somewhat limited function formerly assigned to it by the unscientific philosopher—namely, that of affording delight to man by its beauty —it subserves the truer and more logical mission of aiding materially the increase of the race to which it belongs, and of which it forms such a characteristic part.

Turning to the primrose for practical illustration of the foregoing precepts, we may readily enough find in its structure plain instruction in the build of the flower. The circle of green leaves placed outside the yellow blossom is, of course, the calyx. This green cup consists of five leaves or sepals united in the primrose, but free and easily separable in the buttercup or wallflower (Fig. 1, A, *ca*). The blossom or corolla (Fig. 2, *co*) of the primrose exhibits similarly a united condition of parts. We can tell that it consists of five petals, or leaves, by counting its prominent lobes or projections. When we tear the corolla in two, longwise, we readily perceive the five stamens (*a*), which, however, in the primrose, exhibit a somewhat peculiar position, in that, instead of arising from the end of the flower-stalk, like the other organs of the flower, they spring from the sides of the united petals (Fig. 2). If we seize the corolla of a primrose by its upper

portion, and pull it gently upwards, the entire blossom with its attached stamens will become detached from the flower-stalk, leaving the calyx and pistil on the latter organ. Then tearing or cutting away the calyx, we may be favoured with a clear view of the pistil itself, seated on the extremity of the flower-stalk. In the pistil (Fig. 9) we behold a body consisting below of the swelled or rounded pisturi already mentioned, the ovary (*ov*), which, being cut across, is seen to contain numerous seeds or ovules, as the case may be, arranged around a central pillar named the *placenta*. From the upper part of the ovary arises a long stalk, the style (*st*) of the pistil; and the style, in its turn, is capped by a flat head, the stigma (*sg*). In the pistil of the primrose we therefore see the three typical parts, already noted as constituting the central organ of the flower. The pistil in this case, it may be remarked, consists of five carpels, so closely united that it is only by the aid of the "law of symmetry" (or that demonstrating the general correspondence of numbers in the flower-parts) that we can determine its composition. Five is the ruling number in the calyx, corolla, and stamens. Hence we conclude that the pistil of the primrose in its composition will conform to the type of the other whorls of the flower.

The physiology of the flower naturally follows the consideration of its structure. Living action, in other words, forms the natural corollary to living machinery or structure; hence we may fitly inquire into the manner in which the work of fertilisation is carried on in the economy of the primrose. Leaving for after treatment, the more special features of fertilisation, the general scope of the function whereby, as we have seen, the immature "ovules" are converted into "seeds"—each capable of developing, when planted, into a new primrose—may be readily appreciated. The stamens, each possessing as its essential part the *anther* or head (Figs. 7 and 8, *a*), develop the yellow dust, or pollen, as one of the two elements concerned in the work of plant-development and reproduction. Sooner or later, the anthers of the stamens open in one way or other so as to allow the pollen to escape; and, viewed under the microscope, the pollen-grains are seen to vary greatly in size and form in different species of plants. The grains of pollen may be round (Fig. 11) or oval in form; in the evening primrose (Fig. 13) and fuchsia, they are of triangular shape; in the hollyhock and melon (Fig. 14) they are spinous; and in the orchids they are united to form masses (Fig. 12) called *pollinia*.

The pollen-grains being conveyed to the stigma (Fig. 9, *sg*) of the pistil, they are there attached by the aid of a glutinous secretion, which

may likewise be credited with a specific influence on the pollen-grains, in that it appears to stimulate the curious development they next evince. This development consists in the rupture of the outer

FIG. 11. POLLEN-GRAINS EMITTING POLLEN-TUBES.

FIG. 14. POLLEN-GRAIN OF MELON EMITTING CONTENTS.

FIG. 12. POLLEN-MASSES OF ORCHID

FIG. 13. POLLEN-GRAIN OF EVENING PRIMROSE (MAGNIFIED).

of the two layers of which each pollen-grain consists. Through the ruptured outer coat, the inner layer begins to grow in the form of a long tube—the *pollen-tube* (Fig. 11)—which penetrates the tissue of the style (Fig. 15), and grows downwards to reach the ovules contained in the ovary. In some plants the pollen-tubes emitted from one pollen-grain may be very numerous, although as a rule one tube grows from each grain.

Now, the essence of fertilisation (*i.e.* the production of a "seed" fitted to produce a new plant) appears to consist in the contact of the pollen-tube with the ovule, so that the viscid matter called *fovilla*, contained within the pollen-grain, may be applied to the structures of the ovule. The most important part of the ovule itself is a small cellular body called the *nucleus*, enveloped in a couple of coverings. The hollow interior of the nucleus is named the *embryo-sac*, and an opening called the *micropyle* also exists in the coats of the ovule. Through this opening the pollen-tube passes, gaining admittance thereby to the nucleus, and thence to its hollow or embryo-sac, wherein the fovilla, or contents of the pollen-grain, are discharged. Such is the

work of fertilisation, and such are the processes in virtue of which the ovule becomes the seed. As the result of these processes, the "embryo," or young plant, is duly formed within the embryo-sac,

Fig. 15. Pollen-tubes of Datura penetrating the style (Magnified).

and thus, even before the seed is planted, development has already proceeded to a certain extent. In the seed of a pea or bean (Fig. 16), for instance, we readily perceive the rudiment of the stem (*p*), the beginning of the root (*r*), and likewise the first appendages or "seed leaves (*c*)," which that stem will develope. The process of fertilisation, thus described in its essential nature, involves in the case of certain plants some curious details, the mere mention of which may stimulate to an independent research into botanical lore. Thus, often the pollen-tubes may require, from the length of the style of the pistil, to grow to a large relative extent. In the crocus, the pollen-tube requires to grow to a length of 3 inches before it can reach the ovules in the ovary. The number of pollen-grains in flowers may be

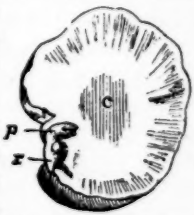

Fig. 16. Section of Bean.

apparently in excess of all reasonable proportions—a fact to be accounted for on the well-founded idea that the pollen of a flower is not usually limited to that particular flower's wants, but may be destined to serve for the fertilisation of others of the same species. In the great flowered cactus (*Cactus grandiflorus*), Morren says there are about 500 anthers, 24 stigmas, and 30,000 ovules. Assuming that each anther contains 500 pollen-grains, this will give a total of 250,000 grains to each flower; and the interval or space between the stigma and the ovules of this plant is about 1,150 times the diameter of the pollen-grains. Nature appears exceedingly lavish in her development of pollen. If the Tennysonian aphorism that—

> Of fifty seeds
> She often brings but one to bear,

be true—as it unquestionably is—the apparent over-production of pollen-grains is even more remarkable, although we have to take into account the fact just noted, that the development of pollen bears a relation rather to the species and race than to the individual necessities of the plant. Otherwise, Fritz Müller's estimate, that in a single flower of *Maxillaria* there are developed 34,000,000 grains of pollen, must present itself as an inexplicable fact of botanical science. Even the wheat-plant produces about 50lbs. of pollen to the acre. And the pollen of the cone-bearing plants (*Coniferæ*), such as the firs, larches, pines, or that of the catkin-bearers (*Amentiferæ*), is often borne through the air as showers of yellow sulphur-like dust, which, falling in regions where the elements of botany are unknown, cause perturbation amongst the unlearned, and result in the penning of epistles to "Mr. Editor" by way of inquiry whether or not the sulphureous shower is a portent or grave omen of coming disaster or impending peril.

The phenomena of fertilisation just detailed take place in our primrose, as in all ordinary plants; but whilst there exists a uniformity in the details of this process, there is also found a literally amazing variety in the fashions whereby pollen is conveyed to the stigma of the pistil. Once placed in the natural position for fertilisation, the growth of the pollen-tube follows as a matter of course. But the means whereby the pollen reaches the stigma, and the various fashions in which it may gain its ultimate position on the pistil, constitute features in which are bound up some of the most important issues of plant existence. To rightly comprehend the bearing of fertilisation, a glance at our wallflower (Fig. 1, A), primrose (Fig. 2), foxglove (Fig. 1, B), or buttercup will suffice as a starting-point for further investigation. Within the primrose and the buttercup are situated, as

we have seen, the two sets of organs—stamens and pistil—necessary to secure the production of seed and the continuance of the race. Hence it might form a very natural and reasonable inference, that the pollen from the numerous stamens of a buttercup flower should be used to fertilise the ovules of the pistil of that flower. Such a process—that in which a flower's own pollen is used to fertilise its own ovules—is termed "self-fertilisation." Looking at the vast majority of our flowers and plants, which possess each a perfect array of stamens and pistil, the normal course of things seems strongly suggestive of self-fertilisation. Hence, in the days of Linnæus, self-fertilisation was undoubtedly believed to be the rule of nature. Now, there can be no question whatever that "self-fertilisation" does occur in nature, but there is as little doubt that it is the exception, and not—as botanists from the days of Linnæus well-nigh to our own day have maintained—the rule, of plant life. There can be little doubt, for instance, that many small species of the buttercup order (*Ranunculaceæ—e.g. Ranunculus hederaceus*) are self-fertilised, because we find the stamens to arch over the pistil, and to shed their pollen on the carpels. In *Agrimonia*, in the same order, the stamens, at first curved outwards, curve inwards, so as to bring the pollen within easy reach of the stigmas. So, also, in a species of Malvaceæ (*Malva rotundifolia*), Müller has demonstrated that this plant is self-fertilised, since stigmas and anthers actually intertwine, and are thus placed in the most favourable position for the fertilisation of the ovules. Some species of *Geraniaceæ* (*e.g. Geranium pusillum*) are self-fertilising likewise; and many flowers belonging to the rose tribe (*Rosaceæ*), such as *Potentilla*, fertilise themselves.

It is a remarkable fact that in certain plants (*e.g.* many violets; *Lamium amplexicaule*; *Oxalis*, &c.) very small, inconspicuous, and closed flowers are produced in addition to the ordinary conspicuous and, as we shall see, "cross" or insect-fertilised flowers. These closed flowers have been named "cleistogamous"—a term applied by Kuhn in 1867. They are self-fertilised, and produce numerous seeds; and their occurrence in the same plant along with cross-fertilised blossoms may perhaps be best explained on the theory that, whilst the ordinary and less fertile flowers will afford to the plant the advantages and benefits which accrue from "cross-fertilisation," the "cleistogamous" flowers may be regarded as the normal means for the ordinary increase of the race. What the flower loses in variation by the sparing fertility of the cross-fertilised flowers, it may gain in the number of seeds which the cleistogamous flowers produce. Cleistogamous flowers likewise tend to economise pollen.

Whilst 400 pollen-grains may serve the purpose of close or self-fertilisation in *Oxalis*, or even 100 grains in some violets, three-and-a-half million grains may be produced in the insect-fertilised flowers of the peony, and many millions in the case of wind-fertilised flowers, whose pollen, like that of the firs, has to be distributed over immense areas of land.

There appears, therefore, to be a proportion of plants in which the existence of stamens and pistil in the same flower—the normal condition of matters in ordinary plants—is meant to and does secure the fertilisation of the ovules by the flower's own pollen. Why, then, seeing that the presence of correlated stamens and pistils in each flower appears to be a common condition of plant life, do we assume that not self-fertilisation but the opposite process—*cross-fertilisation*—is the rule of nature? The reply to this query involves more than one important consideration. Let us briefly endeavour to find a convenient starting-point in the familiar flower which Peter Bell despised, and which, to minds of utilitarian type amongst ourselves, is but a primrose still, and "nothing more."

If we study the structure of the primroses we may gather in a bed of these flowers, it will be found that the blossoms obtained from one set of plants will vary in certain respects from the flowers of the other and neighbouring plants. There is no difference in appearance or in outward aspect between the primroses, because the differences referred to merely affect the position of the stamens and the length of the style (or "neck" of the pistil) in each variety. But we may readily discover that, selecting any one primrose plant, all the flowers of that plant will be either long-styled (Fig. 2 A) or short-styled (Fig. 2 B), and will not exhibit a mixture of the two varieties. "The two kinds of flowers," says Mr. Darwin, speaking of the long and short-styled cowslips, which form a closely allied species to the primroses, "are never found on the same individual plant;" and he also remarks that he has never met with any transitional states between the two forms growing in a state of nature. The cowslips and other allies of the primrose exhibit a like disposition of parts. Thus, when we slit one of the primroses longwise, we see that the stamens (Fig. 2 B, *a*) are placed high up on the petals or near the top of the corolla, and the style is comparatively short. In the other variety (Fig. 2 A, *a*), the stamens are placed far down within the tube of the corolla, whilst the style is so long that the stigma (*sg*) appears to block up the entrance to that tube, and reaches to the top of the petals. Thus we speak of "short-styled" (B) and "long-styled" (A) flowers in primrose and in all other plants in

which these conditions occur; whilst, popularly, the short-styled forms are called "thrum-eyed," and the long-styled ones "pin-eyed." Such a disposition of stamens and pistil also occurs in *Pulmonaria officinalis*, in *Linum perenne*, and in other plants, which are hence called *Dimorphic, i.e.* having two forms of flower. And in some plants (*e.g.* Oxalis and the Spiked Loosestrife or *Lythrum Salicaria*), three varieties of flowers are known, and these latter are named *Trimorphic* in consequence.

Returning to our primroses, we find that the pollen-grains of the two forms of flower differ in size. Those of the long-styled primroses (A) are smaller than those of the short-styled flowers. Mr. Darwin remarks of the pollen-grains of the latter flowers, that "before they were soaked in water, they were decidedly broader, in proportion to their length, than those from the long-styled; after being soaked, they were relatively to those from the long-styled as 100 to 71 in diameter, and more transparent." Mr. Darwin also compared these two forms of flowers in other respects. He found that the seeds of the short-styled flowers "weighed exactly twice as much as those from an equal number of long-styled plants," the short-styled being the more productive of the two forms. As final facts concerning the differences between the two varieties, it may be noted that the stigma or head of the pistil in the long-styled form is more distinctly globular and roughened on its surface than that of the short-styled primroses; whilst the stigma in each form stands nearly, but not quite, on a level with the anthers of the opposite variety.

What can be affirmed, as a matter of observation, to be the meaning and purpose of this diverse arrangement of stamens and pistils in these plants? Meaning it must have, and that one which is closely bound up with the history of the species. So it was found, when, through Darwin's researches, contributed to the Linnæan Society's Transactions in 1862, it was clearly demonstrated that the arrangement in question had reference to the *cross-fertilisation* of the primroses and of all other plants in which a like diversity of structure was found. Mr. Darwin then pointed out that the structure of the primrose was eminently adapted to favour the visits of insects as aids in procuring the fertilisation of the long-styled flowers by the pollen of the short-styled flowers, and *vice versa*. Such an interchange of pollen is accomplished in a manner readily understood. Suppose that an insect —such as a humblebee—first visits a long-styled flower (Fig. 17, 2), drawn to the primrose in search of the nectar which this flower, the cowslip, and other members of the genus secrete in quantity. The proboscis of the bee will be thrust into the tube of the corolla, and

in the act of nectar-gathering will unconsciously dust its proboscis with pollen nearer the tip of that organ than the base. Suppose next that the bee, with its pollen-laden proboscis, flies to another primrose plant of the short-styled variety. The proboscis, inserted therein as before, will come into contact with the low-lying stigma, and upon this surface will be left the pollen which was gathered from the stamens of the long-styled flower. Thus interchange the first is accomplished. But when visiting the short-styled flower (1), the bee's proboscis, coming in contact with the stamens (placed at the top of the flower), is dusted near the base with short-styled pollen. Hence the next visit paid to a long-styled flower results in the placing of pollen from the short-styled flower upon the stigma of the long-styled primrose. The stigma of the latter is placed, as we have seen, at the top of the flower (Fig. 17, 2), and it is thus well calculated to meet the base of the bee's "tongue," which has been dusted with short-styled pollen. Interchange the second is thus accomplished, and the *cross-fertilisation* of the primrose race becomes a matter of well-nigh absolute certainty. As indicated in the annexed figure, from Darwin (Fig. 17), the "legitimate" (A) fertilisation is that which occurs when pollen from the long-styled form is placed on the short-styled pistil, and *vice versâ*. The "illegitimate" fertilisation (B) is self-fertilisation in either case; namely, through the pollen of either flower being placed upon its own stigma. Darwin's own words, applying to his observations on the cowslip (*Primula veris*), may be read with interest as applying likewise to the similar arrangement in the allied primrose. After noting that humblebees, and likewise moths, visit these flowers, Darwin says: "It follows from the position of the organs (anthers and stigmas) that if the proboscis of a dead humblebee, or a thick bristle or rough needle, be pushed down the corolla, first of one form and then of the other, as an insect would do in visiting the two forms growing mingled together, pollen from the long-stamened form adheres round the base of the object, and is left with certainty on the stigma of the long-styled form; whilst pollen from the short stamens of the long-styled form adheres a little way above the extremity of the object, and some is generally left on the stigma of the other form." Mr. Darwin is also careful to note that "self-fertilisa-

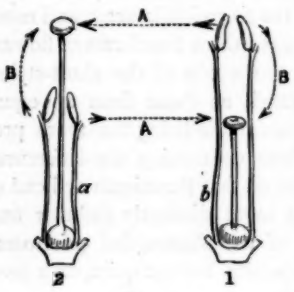

FIG. 17.

tion" must occasionally occur in these flowers, through "an insect, in withdrawing its proboscis from the corolla of the long-styled form," leaving pollen from the flower on that flower's own stigma. Such a result will occur most frequently in the case of the short-styled flowers, as may be experimentally demonstrated, and small insects, such as those belonging to the genus *Thrips*, wandering aimlessly about within the flower may likewise be the means of inducing self-fertilisation. But, as if in anticipation of such defeat of her clear intent and purpose, we find a very significant observation brought to light in the fact that even if a flower's own pollen be placed on its pistil, *cross-fertilisation* may yet take place, inasmuch as pollen from a different form of flower seems to be capable of obliterating the effect of the flower's own pollen, "even," adds Mr. Darwin, "when this has been placed on the stigma a considerable time before." An experiment of very crucial nature supplies an instance of the pre-potent effect of foreign pollen over a flower's own. On the stigma of a long-styled cowslip Mr. Darwin placed "plenty of pollen from the same plant." After a lapse of twenty-four hours he added pollen "from a short-styled dark-red polyanthus, which is a variety of the cowslip. From the flowers thus treated thirty seedlings were raised, and all these, without exception, bore reddish flowers; so that the effect of pollen from the same form, though placed on the stigmas twenty-four hours previously, was quite destroyed by that of pollen from a plant belonging to the other form."

The philosophy of primrose-existence can hardly be said to be in any sense comprehended through the mere knowledge of the contrivances which exist in that flower for the prevention of self-fertilisation and the favouring of the opposite process. On the contrary, the philosophy which carries with it the understanding and appreciation of the system and order of nature is only discernible when, firstly, we step forth more fully "into the light of things," and when, secondly, we discover, from such wider views of flower-life, the advantages gained and the ends served by the processes under consideration. Hence, for the present, we may turn with profit from the polity of a primrose to discuss some analogous feature in that wider realm of flowers to which the primrose and its kind may fitly introduce us. After such survey we may, with additional likelihood of arriving at just conclusions respecting the philosophy of plant-life, return to the Primula and its lessons once more.

It has been already remarked that self-fertilisation is the exception and cross-fertilisation the rule of plant-nature. At any rate, the cases where cross-fertilisation is obviously the process which by

manifold contrivances nature seeks to further and effect, increase in number year by year. Although self-fertilisation does occur, and is a possibility even with normally cross-fertilised plants, yet the whole drift of modern botanical teaching tends towards the recognition or the mutual interchange of pollen betwixt related flowers as the normal way of plant-reproduction. Nor do the comparative results—to be hereafter detailed—of cross and self-fertilisation in the least degree vitiate these conclusions. On the other hand, every fact of botany dealing with ascertained results of the one method of fertilisation, as compared with those obtained by the other, testifies to the enormous gain, possible and actual, to the plant-creation through the effects of cross-fertilisation. The presence of so many different methods whereby this end is secured constitutes an eloquent fact in favour of the supposition that the normal way of plant-life undoubtedly lies in the direction of pollen-interchange, as a necessity for energetic development and for the full fruition of the races and tribes of plants that people earth's firmament.

Within the limits of the present paper it would be impossible to enter into the discussion of those peculiarities of insect structure which have been developed or modified in turn like the forms of flowers for the due performance of the work of cross-fertilisation. It may suffice at present to simply point out that the conformation of the legs of certain insects, as well as the form of the mouth-parts, and even the hairiness of body or the reverse conditions, all bear witness to special adaptation in different insects for the fertilisation of special flowers. Certain insects are known to confine their visits to special plants—some to one species of plant only; and probably, when this department of the subject is more fully and completely studied, the number of cases in which insect-visitation is of a rigid or exclusive kind, will be largely increased.

The two chief methods of cross-fertilisation, or, in other words, of flower-fertilisation at large, are thus: (1) insects, or more rarely birds, snails, &c.; (2) the *wind*; whilst (3) pollen may be floated *on water* from one plant to another, as in the case of *Vallisneria spiralis*. Botanists term plants fertilised by insects "entomophilous," and those fertilised by the wind "anemophilous." Some plants, *e.g.* common rhubarb (Darwin), and some species of Plantago (Delpino and H. Müller) exhibit an intermediate condition, in that they may be fertilised in either way. The wind-fertilised plants, as an "invariable rule," according to Darwin, possess small and inconspicuous flowers, whilst the insect-fertilised flowers, as might be expected, are conspicuous, or, if not brightly coloured, are strong smelling. Moreover,

there are certain conspicuous differences between the pollen and its quantity, and between the form of the stigma, &c., in wind-fertilised and insect-fertilised flowers.

The pollen of the wind-fertilised plants is produced in far greater quantity than that of the insect-dependent flowers. Then, also, the former flower opens before the leaves are in full growth, in order that the clouds of pollen may gain easy access to the pistils; whilst their stigmas are usually branched and bending (*e.g.*, alder, wheat, &c.), so as the more readily to intercept and detain the pollen in its wind-flights. Allusion has already been made to the showers of pollen emitted by coniferous trees, and it may be added here that bucketfuls of pollen from conifers and grasses are occasionally swept off the decks of vessels off North American coasts; whilst North American lakes may be covered over a considerable area of their surface by the yellow pollen of the pines. Most of our cereals are presumably wind-fertilised; and the importance of light breezes in the early summer may therefore be a matter of consideration in respect of the full ears of autumn. Hooibrenk and Kœrnicke, in their practical suggestion, carried out in Belgium and Germany, of drawing a rope across the full-flowered ears so as to distribute pollen and cross-fertilise the plants, seem therefore to have imitated nature's method. The question of the wind-fertilisation of the cereals, it may be remarked, however, is at present an open one, since some botanists elect to believe that the wind-distributed pollen is simply the excess or useless pollen remaining after fertilisation has been accomplished; the actual agency in scattering abroad the fertilising dust being said to be the sudden extension and elasticity of the stalks of the stamens.

That cross-fertilisation is the rule of nature is a fact amply demonstrated by the well-nigh endless contrivances in flower-structure, form, appearance, and function, through which the interchange of pollen is brought about. Let us briefly glance at the outlines of such a study. Allusion has already been made to cases in which a separation of stamens and pistil takes place as a normal condition of many plants. Such separation may proceed to the extent of placing stamens in one set of flowers, and pistils in another set on the *same* plant; or it may be illustrated by the more complete isolation of these organs, so that in the latter case we find all the flowers on one plant to be "staminate," and all the "pistillate" flowers to be borne on another plant. The lesser nettle, for instance, has its stamens and pistils in different flowers on the same plant, as also have the oak, melon, cucumber, maize, hop, hazel, carex, &c. The greater nettle, on the other hand, bears on one plant none but staminate

flowers, and on another plant none but pistil-bearing flowers; whilst hemp, willow, the variegated laurel (*Aucuba Japonica*), palms, &c., also illustrate the complete separation of stamens and pistil. Other conditions, more or less uniting these dispositions of the stamens and pistil, may be found in flowers. In a daisy—which is a collection of flowers—we find the outer or white florets to possess pistils but no stamens, and the yellow and central florets to possess both stamens and pistil. We can readily discern that all such arrangements secure pollen of essentially foreign kind for fertilisation. Self-fertilisation is, in fact, impossible in such cases as those just described; and some very curious facts are found in botanical archives concerning the difficulties experienced in obtaining "seeds" where one of the necessary elements —usually the pollen—for fertilisation was absent. The variegated laurel presents a case in point. The first specimen of this species introduced from Japan was a pistillate or female plant, and could produce ovules from its flowers, but no "seeds," inasmuch as no pollen from another and staminate plant was forthcoming. The plant was largely reproduced from slips alone until within comparatively recent years, when staminate plants being imported, pollen was then forthcoming for the production of seed. The Egyptians have long been in the habit of bringing palm-branches bearing stamens from the desert, in order to fertilise the domesticated pistillate or fruit-bearing palms grown at home. This necessary process was frustrated in 1808, when the French occupied Egypt, and when the stamen-laden branches could not, in consequence of foreign invasion, be procured. In the well-known *Vallisneria spiralis*, a water-plant of Southern Europe, which, like the willow and palm, has stamens and pistils on separate plants, the pistillate flowers are borne to the surface at the proper period by the relaxing of a spirally coiled stalk on which they are supported. The stamen-bearing flowers, on the contrary, are borne on short stalks, and, becoming detached therefrom, float to the surface of the water. There they scatter their pollen, which reaches the pistillate flowers, and the latter being fertilised, are drawn by their stalks once more beneath the water, where the seeds mature and the fruit in due course ripens.

The present is perhaps a fitting stage of our inquiries to remark that the tendency towards cross-fertilisation in nature is nowhere more strongly marked than in cases where a plant is utterly infertile with its own pollen, but perfectly fertile when impregnated with pollen from another plant of the same species, or, in some notable instances, from an entirely different species of plant. Species of passion-flowers have been found sterile with their own pollen,

although "slight changes in their conditions, such as being grafted on another stock, or a change of temperature, rendered them self-fertile." More extraordinary still, however, is the knowledge of the fact that the pollen of some orchids actually acts like a poison if placed in what one would have deemed the most natural position for it, namely, on their own stigmas. Such facts as these entirely alter the former conceptions of a "species," as a group the members of which were fertile *inter se*, but infertile with members even of nearly allied species; and such knowledge supplies a wholesome corrective to the theory that species are separate, independent, and distinct entities both as to origin and after-relations.

If nature contrives by such means to effect cross-fertilisation, there exist ample fields for the demonstration of a like result in other and very varied fashions. In a very large number of flowers, for instance, the stamens ripen and discharge their pollen before the pistil is ripe, or the ovules ready for fertilisation. In other cases, but more rarely, the pistil ripens before the stamens. The former case is illustrated by most species of geraniums, pelargoniums, by harebells, and other *Campanulaceæ* (Fig. 6, A), by many umbelliferous plants, by pinks, sweetwilliam, and allied plants, and by many plants of the daisy and dandelion type (*Compositæ*). The latter case (of the earlier ripening of the pistil) is illustrated by the rib-grass (*Plantago*) of the roadsides, by the cuckoo pint (*Arum*, Fig. 18), and other plants. One or two familiar illustrations will suffice to show how clearly and effectually nature carries out her intention of securing cross-fertilisation by different periods of ripening in stamens and pistils.

The pink, or carnation (Fig. 19), in its first condition, exhibits the case of a plant possessing stamens alone. These organs ripen, discharge their pollen (which is carried by insects to flowers whose pistil may be ripe), and then die away. After the stamens, and with them all chances of self-fertilisation, have disappeared, the pistil matures, and its style and stigma develope fully (Fig. 19), and it is then fertilised by foreign pollen—that is, by pollen from a pink whose stamens are at that period in full development. So also is it with thyme, whose stamens ripen first; and with the Canterbury bells, harebells, and like flowers. In the campanulas, anthers and pistil are closely related before the flower opens; and when the anthers discharge their pollen, it is shed upon the style or stalk of the pistil; and only after the stamens have shrivelled up and their pollen has been carried away by insect agency to other "bell-flowers," does the pistil develope fully, and its three conspicuous stigmas open out so as to receive pollen from another and, at that period, pollen-producing flower. In

cases like the preceding, therefore, it is evident nature does not intend that the flower's own pollen should fertilise its ovules. The opposite case occurs in the Plantago, where the elegant little pistils

FIG. 18. ARUM.

FIG. 19. CARNATION, SHOWING THE RIPE PISTIL.

ripen first, and where the stamens do not mature until fertilisation of their flower has been accomplished by foreign pollen. In the cuckoo pint (*Arum*, Fig. 18) there is also witnessed the ripening of the pistil before the stamens. Every one knows this plant, with its sheathing leaf (*a*), and the central stalk (*b*) bearing the "flowers." The anthers are placed above the stigmas; hence it would seem, at first sight, as if nature intended that their pollen should fall downwards and fertilise the plant's own ovules. But the pistils ripen long before the stamens. When the latter are mature, the pistil has been already fertilised; hence the pollen, it is evident, must be intended for fertilising other pistils of the species, unless, indeed, we can maintain that nature, like Homer, "sometimes nods." The pollen in this case falls to the bottom of the sheathing leaf, where it might well seem to be

lost entirely to the outer world. Small insects, however, in due course arrive upon the scene. Entering the cavity of the leaf readily enough, on the principle of *facilis descensus Averni*, they find the reverse process, *revocare gradum*, to be impossible. By an arrangement of stiff hairs, pointing downwards, which they readily enough brush aside on entering, they are prevented from escaping out of the flower. Hemmed in by this natural *chevaux de frise*, as in an eel-trap, we may find inside an Arum a hundred or two small insects in durance vile. Here, however, they find nourishment in the honey-secretion, and here they, in due time, work out nature's will, in that they become laden with the discharged pollen. So that when the opposing hairs shrivel and wither away, the insect-crowd disperses itself, and its units, undeterred by reminiscences of their imprisonment, entering other Arums in which the stigmas have just ripened, duly cross-fertilise the latter. Risks of fertilisation being omitted altogether are not lost sight of in the economy of nature, and such contingencies are often duly provided for in remarkable ways. In *Myosotis versicolor* (Fig. 20), for instance, there is an evident intent to prevent self-fertilisation, from the fact that the pistil (*st*) projects far above the stamens (*a*) in the young flower (A), and is therefore a likely object to be touched by an insect which has come from another "Forget-me-not," as this flower is often named. But such an arrangement, dependent on insect visitation, might be rendered futile if no insect happened to alight on the flower. In due time, however, the corolla is seen to increase in length; as it grows upwards, the stamens (*a*) are carried upwards (B), until, in due time, they attain the level of the stigma (*st*), and by discharging their pollen upon it will fertilise the pistil, if it has not already undergone that process from a foreign source. Such a contrivance appears tantamount to the declaration that, although cross-fertilisation is sought and preferred, yet self-fertilisation is better than none.

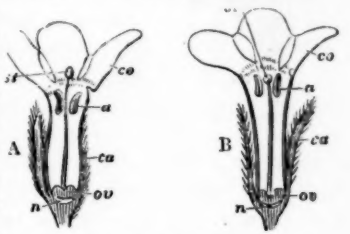

FIG. 20. MYOSOTIS IN ITS EARLY AND LATER STAGE.

Besides the means just noted, there exist a large number of expedients in flowers for securing fertilisation; these latter contrivances relating to the form and shapes of flowers, to the special positions of its organs, and to adaptive details of flower structure. The polity of a primrose, in the peculiar situation of its stamens and pistils, as adapted to secure cross-fertilisation, falls under this latter division

of floral expedients; and so, also, would all these peculiarities of stamens whereby the discharge of pollen in a fashion adapted to avoid self-fertilisation is secured. In some flowers (*e.g. Parnassia*), as the five stamens ripen one after the other (before the pistil, as it happens), each anther is laid back downwards, so to speak, on the stigma or top of the pistil, so that the pollen escapes by the side farthest from the stigma, and self-fertilisation thus becomes well-nigh an impossibility. But even the form and shape or colour of a corolla or blossom may be adapted either of itself, or when associated with other expedients, to secure cross-fertilisation in especial conjunction with insect aid. It has been pointed out that every flower of peculiar shape is cross-fertilised by insects. As notable instances of this fact may be cited the peas, beans, dead nettles (Fig. 21), sage (Fig. 25), salvia (Fig. 23, A), orchids, the peculiar shape of whose flowers, as well as the special arrangements of stamens and pistil, are correlated in the most exact positions to compel insects to visit special parts of the flower, and thus to ensure the exact performance of the work of cross-fertilisation. Even the distribution of colour on a flower, and the particular spots or dashes which attract our notice, are guides and fingerposts directing insects to the honey. Sprengel, of old, called these special colour-guides *maculæ indicantes*, and Darwin remarks, that Sprengel's ideas seemed to him "for a long time fanciful." But the fact that these markings are most commonly met with on unsymmetrical or irregular flowers, the entrance into which would be more likely to puzzle and confuse insects than the apertures of symmetrical flowers, weighs in favour of dashes and spots of colour being truly directive in function. Darwin further remarks that, in the common pelargonium, the marks in question, borne on the two upper petals, are clearly related to the position of the "nectary" or honey-store of the flower; for when the flowers vary so as to become regular, and lose their nectaries, the marks disappear. When the nectary is only in part undeveloped, only one of the upper petals loses its characteristic mark. It is true that humblebees are known to bite through the petals of flowers, and to surreptitiously suck the honey through the apertures thus made, and even hive-bees learn to utilise the holes made by their larger brethren. But, notwithstanding this latter method of securing stolen sweets—a method indicative of a certain

FIG. 21. DEAD-NETTLE IN SECTION.

power of development in bee-intellect—there can be little doubt that originally to bees, as at present to insects who walk in the trodden paths of their race, the colour-marks and special hues of flowers are serviceable, as Darwin remarks, in guiding insects rapidly and without loss of time to the store of sweets, and in thus enabling them to visit a larger number of flowers in a given time than would otherwise be possible. Sir John Lubbock remarks, that he did not realise the import of these markings in flowers until he

FIG. 22 (A).

FIG. 22 (B)

FIG. 22 (C).

saw how much time bees lost, if honey which has been put out for them is even slightly moved from its usual place ; whilst it forms an allied subject of the most interesting description, to speculate upon

FIG. 23 (A).

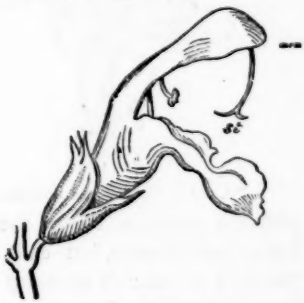

FIG. 23 (B).

the remarkable changes in colour which some plants undergo, and which, like the times of opening and closing, are doubtless related to the visits of insects. Thus, we know of some flowers (*Hibiscus*) which are white in the morning, of a pale rose hue at mid-day, and exhibit a bright rosy red colour in the evening. Many flowers change their hues as the petals wax old and tend to fall off ; and that such alterations of hue have a reference to insect-visits, and attract, it may be, insects of different tastes and structure at different

periods, is by no means a far-fetched speculation. The presence of bright colours in flowers has been shown to bear an important relation to fertilisation, and necessarily, through this latter process, to the development of such species of plants. Bright hues are, as a rule, associated in flowers with a faint development, or even a want of scent. Insects being attracted by one quality or the other, the presence of scent would be useless where colour is well developed. If we compare such flowers as pelargoniums, convolvulus, pansy, fritillary, &c., which are conspicuous and bright-tinted, but scentless,

FIG. 24 (A). SECTION OF FUCHSIA.

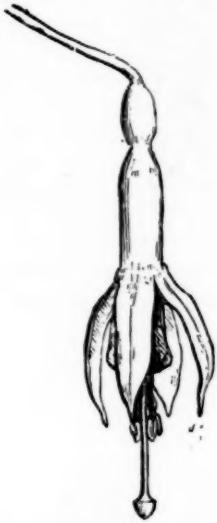

FIG. 24 (B). FUCHSIA.

with the primrose, lily of the valley, rose, and hyacinth, which are not so conspicuous, but emit powerful odours, we can realise the principle of nature's economy in avoiding over-lavish provisions for insect-attraction. The correlation between flower and insect is even more strongly marked, however, when we discover that flowers which are fertilised by night-flying moths are usually of white colour, so as to appear conspicuous at night, and may further emit their odour only or chiefly at night. Such flowers as Daphne and Hesperis—obscurely coloured, as it happens—attract insects solely by their powerful odour. Nägeli's experiment of scenting artificial flowers with essential oils was followed by the attraction of insects "in an unmistakable manner."

The description of a few of the most typical cases in which

cross-fertilisation is found may fitly conclude the more exact consideration of the present topic, and preface the abstract philosophy which directs attention to the bearing of the facts of fertilisation on the constitution and regulation of the world of life at large. A very interesting mechanism for effecting cross-fertilisation is seen in the case of flowers which, like the peas, beans, and their leguminous neighbours, present a very characteristic form of blossom. These flowers possess ten stamens (Fig. 25), nine united to form a bundle, and one remaining single. The flower is peculiar in that

Fig. 25 (A). Flower of Sage.

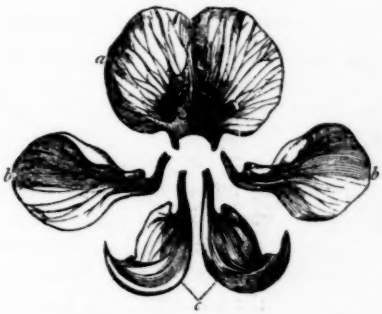

Fig. 25 (B). Flower of Pea dissected

it consists of one very large petal (Fig. 25, B, *a*), behind or above, two at the sides or "wings" (*b b*), and two united to form the boat-shape "keel" (*c*) below. When an insect alights on the side petals or "wings" (Fig. 25, C, *al*), the keel (*c*) is thereby pressed downwards, and the pollen of the stamens (*st*) and the tip of the pistil are made to project, so as respectively to dust the insect's breast with pollen, and to receive therefrom the foreign pollen gathered previously from another flower. Sprengel himself noticed that the union of the stamens favoured this conjoined action. When the weight of the insect's body is removed, the stamens and pistil resume their normal position. If, as Sir John Lubbock remarks, "the two ends of the wings (in a sweet-pea) be taken between the finger and thumb, and pressed down so as to imitate the effect

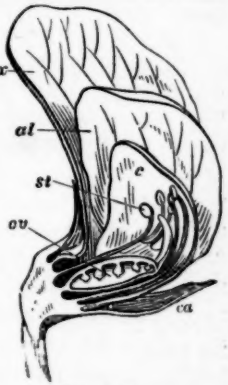

Fig. 25 (C). Section of Pea.

produced by the pressure of an insect, the keel is depressed with the wings, while the pistil and stamens are thus partly uncovered." In the bean, when the wings are similarly pressed down, the stigma of the pistil, and then the "beard" of the style, laden with pollen, project from the keel, which is of coiled conformation. When a bee exercises the necessary pressure, the pistil of the bean will first strike its body and become fertilised by fresh pollen, whilst the pollen-laden style of the flower will, secondly, leave fertilising matter on the bee's body for application to the pistil of another flower.

A dead-nettle (Fig. 21), with its irregular flower, presents a favourable and readily understood example of the manner in which a special form of flower is adapted for the special insect which cross-fertilises it. A bank of dead-nettles is to humble-bees what a country-fair is to juveniles, in that it presents the insects with a store of sweets specially intended for their delectation. In shape, the sage (Fig. 25, A) or dead-nettle flower, as everyone knows, exhibits a wide mouth, bounded by a very much arched upper lip, whilst a divided lower lip is also conspicuous enough. The green cup-like calyx has its sepals united, whilst the very irregularly shaped corolla is composed of united petals. There are four stamens—two long and two short—the fifth stamen of botanical expectation being abortive. The stamens are peculiar in position, inasmuch as they lie along the arch of the petals, instead of surrounding the pistil. The style is very long and forked at its tip (*sg*), and it moreover depends below the anthers as in fuchsia (Fig. 24). The honey for which the bees visit the dead-nettle is situated far down within the flower, and if we make a vertical section of the corolla, we shall find a circle of hairs (Fig. 21, *h*) placed inside the petals at their lower portion. Now, in what special fashion is the mechanism thus described, brought into play in the fertilisation of the dead-nettle tribe? The reply may be found in a simple study of a dead-nettle on a warm summer's day, when insect-life and the blossoming of flowers together seem to attain the acme of activity and development. The bee approaches the flower, and finds in the lower lip of the blossom a convenient door-mat on which to alight. Here the insect gains a *point d'appui* for the movement of the proboscis, which probes the depths of the corolla so as to reach the nectar, and easily thrusts aside the circlet of stiff hairs presenting an impassable barrier to a less robust as well as uninvited insect guest. The acts of the insect, in so far as the work of honey-getting is concerned, end thus. Meanwhile, however, it has likewise been performing its unconscious part in the fertilisation of the flower.

The position of the stamens under the hooded petal has been noted. Such a position assures two results—firstly, that the stamens shall be brought in contact with the bee's body; and secondly, that the pistil shall likewise touch the insect in order that foreign pollen, obtained from a previously visited dead-nettle, shall be deposited on the stigma. The stigma, as we have seen, depends below the anthers. Hence it must be the first object with which the bee comes in contact. Fertilisation by the foreign pollen is thus secured before the stamens have dusted the insect with the flowers' own pollen. As Dr. Ogle has pointed out, the position of the stamens doubtless facilitates in a marked degree the proper placing of pollen on the insect's body. If the anthers had lain side by side, the bee's head might have been dusted on parts which do not touch the stigma as the insect enters the flower; whilst even the eyes of the bees might have become disadvantageously covered with pollen. There is, in short, the closest possible correlation between the structure of the flower and the form and size of the insect which fertilises it.

Such correlation is exhibited in, if anything, an increased degree in the genus *Salvia*, belonging to the dead-nettle order (*Labiatæ*), also including the sage (Fig. 25). Salvia (Figs. 22, 23) attracted the notice of Sprengel—Rector at Spandau—who, in his "Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen" ("The Secrets of Nature in the Structure and Fertilisation of Flowers"), published in 1793, was one of the first to direct attention to the fact that nature's law was "cross" and not "self-fertilisation"—or, as he himself expressed it, "nature does not desire that any complete flower should be fertilised by its own pollen." It is interesting to note that a species of *Salvia* (*S. splendens*) occurring in the New World appears to be cross-fertilised through the agency of humming-birds; these fairy-like birds thus discharging in this case the functions of the insects to which some species approach so nearly in size. The trumpet creepers (*Tecoma radicans*) and trumpet honeysuckle (*Lonicera sempervivens*) are probably fertilised by moths and by humming-birds as well. In *Salvia officinalis* (Fig. 22, A), the general form of which closely resembles that of the dead-nettle, the stamens ripen before the pistil; and as, moreover, the stigma (*p*) is placed above the anthers (*a*), self-fertilisation is an impossibility. When, however, the stamens have shed their pollen, they shrivel up, and the pistil as it ripens developes the stigma, so that it elongates, curves downwards, and thus assumes a position (Fig. 23, B, *st*) in which it cannot escape contact with the back of the bee entering the flower (Fig. 23, A). The insect's back, it may be noted, is

exactly that region which the ripe stamens in a younger and necessarily different flower will have dusted with foreign pollen. But the economy of *Salvia* includes yet other appliances for more effectually securing fertilisation by the insect. There are but two well-developed stamens (Fig. 22, B) in the flower. These organs have widely separated anther-cells; and when in an undisturbed condition, each stamen is seen to consist of a stalk (the *filament*) (*f*), to which another and movable stalk (the *connective*) (*m*), bearing an anther-cell at each end, is attached. Only one of these anther-cells (*a'*) is fully developed in each stamen. The connective, like a swing-bar, can (*m*) be pushed backwards on its axis so as to bring the fully-developed or upper anther-cell (*a'*) to a horizontal position (Fig. 22, C). Such a result is actually brought about by the bee. Thrusting its head into the flower in the search for nectar, the insect pushes before it the

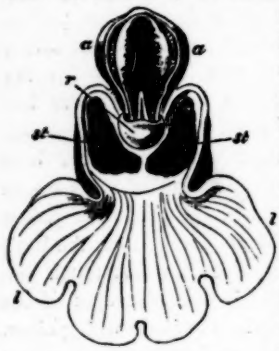

Fig. 26. Orchid Flower.

Fig. 27. Pollen of Orchid.

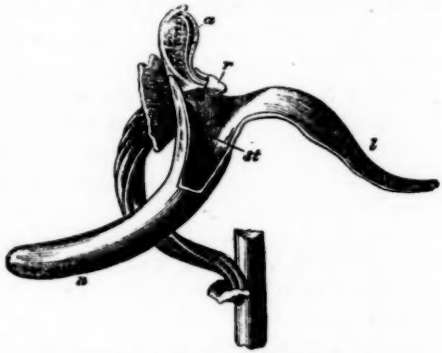

Fig. 28. Section of Orchid Flower.

lower end of the swing-bar, and thus brings the upper end of the bar with its ripe anther (*a'*) in contact with its back (Fig. 23, A). This latter region is thus dusted with pollen, and when the insect flies to another Salvia flower in which the pistil is ripe, the stigma (Fig. 23, *st*), as we have seen, will in due course receive the pollen through contact with the back of the bee.

A single paragraph only is permissible regarding the curious details connected with the fertilisation of the Orchids, which possess

flowers (Fig. 26) of markedly irregular shape. The lip (*l l*) in such a flower as *Orchis mascula*, a common British species, is very broad; whilst the nectary to which bees desire admittance is extremely long (Fig. 28, *n*). The pollen forms two club-shaped masses (Figs. 27, 28 *a*), each adherent to a disc (Fig, 12, *d*), which in turn lies within the *rostellum* or cup (*r*). When touched, the rostellum breaks across, and thus allows the two glutinous discs (12, *d*) to become exposed. When a bee visits this peculiar flower, it pushes its proboscis into the nectary (*n*) for the sake of the honey contained therein. At the same time, the insect comes in contact with the discs of the pollen-masses (Fig. 27), these masses becoming adherent to the insect's head. A pencil pushed into an orchis detaches the pollen-masses after the fashion of the insect's unconscious act. At first, the pollen-masses remain erect like two abnormal horns on the insect's head; but gradually they assume a horizontal position, so that the insect cannot fail to charge the next orchid-pistil it enters with the pollen-masses. The stigma, or top of the pistil (Fig. 26, *st*, *st*), is so placed in these flowers that pollen-masses borne on a bee's head are certain to strike this surface, and thus fertilise the contents of the ovary. It is probable that as each pollen-mass consists of several packets of pollen-grains, one mass may contain material enough to fertilise several flowers; each stigma, through its viscid surface, detaching sufficient pollen from the mass for its fertilisation. The admirable adaptation of flower to insect and insect to flower, thus witnessed, is in no detail better exemplified than in the fact that the pollen-mass at first retains a vertical and then assumes a horizontal position in the insect's head. So long as the pollen-mass is vertical, fertilisation is impossible; and hence the vertical position persists so long as the bee is engaged in visiting the flowers of the plant from which it has derived pollen-masses. Thus self-fertilisation is prevented; so that, as Sir Joseph Hooker puts it, by the time the horizontal position of the pollen-mass is assumed, "the bee has visited all the flowers of the plant from which it took the pollen, and has gone to another plant."

To enter into further illustration of the contrivances through which the fertilisation of flowers is secured would be to encroach on the province of the technical and practical botanist. Such details are "writ large" in the pages of every botanical text-book. In the works of Mr. Darwin—and especially in the "Fertilisation of Orchids"—the reader anxious for further details may find a perfect encyclopædia of facts constituting a veritable romance of botanical science. It, however, remains to us in the present instance

to point out the plain meaning of these virtually marvellous adaptations of the plant-world to the work of cross-fertilisation, and to note, as far as possible, the bearing of such a study upon the order of nature regarded as a harmonious whole. It is a perfectly legitimate supposition that if cross-fertilisation form, as we have seen, such a prominent feature of plant-life, that life must, in some very plain and obvious fashion, benefit therefrom. And further, as plant-life is but a part of organic nature, we may feel perfectly justified in supposing that the conditions and results which cross-fertilisation tends to evoke and produce, will harmonize in their tendency and direction with the course of events through which the living universe has been and is being moulded, developed, and evolved.

To the question, "Why does cross-fertilisation appear to be favoured by nature over self-fertilisation?" a plain reply is at hand in a comparison of the results which accrue from each of these processes. Mr. Darwin's laborious researches on the comparative fertility of various species of plants when self-fertilised and cross-fertilised, supply an answer to the foregoing question by showing that in every respect the cross-fertilised flowers yield more seeds, and give rise to a stronger and more numerous progeny than the self-fertilised. The reader who consults Mr. Darwin's "Forms of Flowers" will find himself supplied with ample data in proof of the advantages of cross-fertilisation. In the primrose, for instance, when short-styled and long-styled flowers were crossed in what Darwin calls "legitimate union," the result was invariably to produce a larger number of seeds than when each form was fertilised by its own pollen. Out of 12 long-styled primroses fertilised by short-styled pollen, 11 good capsules (or ripe pistils) were produced, with an average of 66·9 seeds per capsule; whilst 21 long-styled flowers, fertilised by long-styled pollen, produced only 14 capsules, with an average of 52·2 seeds per capsule. The cowslip gave a similar result; and the tendency towards greater vigour of offspring when cross-fertilisation is employed, appears to be of the most general kind. In some plants, indeed, cross-fertilisation is absolutely essential for the mere continuance of the race; so that this method of seed-production is not merely accidental or advantageous, but absolutely necessary for the continuance of the race. Most of the orchids illustrate this state of matters; the presence of humblebees is well-nigh an absolute necessity for the continuance of the heartsease (*Viola tricolor*); and the well-known case of the clovers may be cited as highly characteristic of the benefits developed through cross-fertilisation. Twenty heads of Dutch clover, protected by Darwin

from bees, yielded no seeds: whilst twenty heads growing exposed as in a state of nature, yielded 2,290 seeds. One hundred heads of red clover protected from bees were absolutely sterile; a second hundred exposed yielded 2,700 seeds. The scientific demonstration of the interdependence of living beings becomes in this fashion perfectly clear. Carried out to its ultimate results, such demonstration becomes sufficiently startling. British brain and sinew depend, according to a foreign estimate, on home-fed beef; whilst the quality of that nutriment is said to be dependent upon the clover on which the ox subsists. But clover owes its continuance to humblebees; humblebees in turn are killed by field-mice, whilst cats extirpate the rodents; and as old maids conserve the feline race, it is alleged that the continuance of the British intellect is dependent upon such conservation—so that a scientific justification of spinsterhood is thus rendered possible.

Sprengel laid down the axiom, already mentioned, that "Nature does not wish any complete flower to be self-fertilised." Darwin in turn improves upon this dictum in his assertion that "Nature abhors perpetual self-fertilisation." That "cross-fertilisation is generally beneficial, and self-fertilisation injurious," is thus a stable result of botanical investigation. This result may not enable us fully to comprehend that "law within the law" which regulates the well-being of the plant-world; but it may at least lead us plainly enough to a nearer fact of life—namely, that there exists in nature an innate tendency to variation and change, and that by furthering the fullest possible development of seeds, as well as by the cross-fertilising of plants, there is being illustrated that tendency to evolve new varieties and species on the existence of which the very idea and possibility of evolution depends. The tendency to produce a more numerous offspring gives naturally a larger number of individuals for the exhibition and operation of the laws of variation. The process of cross-fertilisation itself produces another tendency to variation; and as such variation is the "key-note" of evolution, it is more than interesting to find the conditions of plant-life in such a marked manner contributing to the differentiation of the species.

The whole array of features embraced in a study of flower-fertilisation forms simply a mass of evidence that the production of new races and varieties, and, through these, of new species, is part and parcel of nature's constitution. On any other supposition, the extraordinary array of contrivances favouring cross-fertilisation and the initiation of variations is meaningless and utterly inexplicable. The facts of fertilisation, like the stages of development, present us with un-

impeachable evidence in favour of the evolution of new races by the modification of the old. Even if a fact here or a detail there may seem to weigh against the theory of development, it must be borne in mind, firstly, that defects and gaps in our knowledge are still realities of biological science; and, secondly, that the general—and in this case the immensely overwhelming—probability of nature's and life's methods testifies to evolution as the true way of creation. Darwin succinctly enough says, that his experiments on intercrossing show that "with animals and plants a cross between different varieties, or between individuals of the same variety but of another strain, give vigour and fertility to the offspring; and, on the other hand, that *close* interbreeding diminishes vigour and fertility." And he also adds that such facts "alone incline me to believe that it is a general law of nature that no organic being fertilises itself for a perpetuity of generations; but that a cross with another individual is occasionally —perhaps at long intervals of time—indispensable." Remarking the strange feature of the stamens and pistil of most flowers being placed closed together, "as if for the very purpose of self-fertilisation," and yet being "mutually useless to each other," Darwin says, "How simply are these facts explained on the view of an occasional cross with a distinct individual being advantageous or indispensable!" Thus, from the common ground that cross-fertilisation effects the greatest good in nature—namely, the efficient increase of the race—we may find many roads and ways for the recognition of further effects of such action in favouring the operation of the conditions that increase the species by variation and modification. The full bearing of the subject may not be fully investigated for years to come. Sufficient, however, is our present recognition of the fact that in the work of flower-fertilisation lie the beginnings of those activities and processes which herald now, as of yore, not merely the increase, but the variation of species and the evolution of new forms of plants.

Certain matters bearing the same relation to our present subject that the inevitable moral bears to the fable—albeit that they may perchance be regarded as of somewhat superfluous nature—may fitly be touched upon in closing this paper. Our notions of special ends, aims, and contrivances in nature may in one way be enlarged by the considerations which the phenomena of flower-fertilisation present to notice. Under the operation of laws and conditions most of which are as yet beyond our ken, we see insect acting upon flower, and flower in turn reacting upon insect, until the interdependence in some cases proceeds so far that the extinction of the insect means the disappearance of the flower. But, whilst viewing the beauty of

form and hue exhibited in the plant-world as wrought out by laws of development, and as accessory, or even primary, conditions in the evolution of living beings, the new and higher aspects of the subject bid us regard floral beauty as subserving other and higher uses than those commonly assigned to it, namely, of ministering to the often dull and inappreciative senses of man. We may detect a higher purpose in plant life than is included in the yet too common idea that man's delight and human interests exclusively determine and rule—through what some are pleased to call "the beneficence of providence"—the concerns of nature at large. The utilitarian cry of "use" and "no use" is by no means extinct, even in these latter days; and the consideration of the ways and means involved in the fertilisation of flowers must devolve a strong argument against the homocentric idea that the beautiful in nature exists solely for the behalf of man. Darwin says, "Such doctrines, if true, would be absolutely fatal to my theory." But there is little fear that the hypothesis in question can suffer from arguments familiar in days when natural theology was strained and wrested to its destruction. A truer and a higher use for the beauty of plants and of animals as well is found in the special advantages which such beauty confers upon the race. In the animal, beauty appears as an aid to the propagation of the species, as it is in the plant; and it is by the action of insects that the beauty of flowers has been extended and developed. The beauty of the blossom is in truth due to the visitations of the insect races which in the past have selected its petals as a feeding-ground, and which have strengthened and increased the flower race, thus favoured by a true "natural selection," in the universal struggle for existence. The higher ideas of nature thus implanted form no mean fruits of a study of the polity of primroses and other common flowers. Such studies correct the idea that this world is simply a huge workshop, filled with specially contrived mechanical appliances for man's use and benefit, or a gaudy saloon decked out with beauty for the indulgence of his senses. Those who hold such views may not complain if their belief be logically extended to include the theory that fur-seals were specially created to afford us seal-skin jackets, and humming-birds designed to trim the hats of fair wearers in the fleeting fashion of the hour. So that, if no greater excellence be traceable in the theory of evolution than is involved in the correction of false notions of the aims and ends of nature, those who pursue science-studies even to this extent will reap a rich harvest of rational ideas concerning the true ordering of this universe, especially within the domain of life itself.

ANDREW WILSON.

DREAMS AND THE MAKING OF DREAMS.

DREAMS are night-thoughts, unchecked by the judgment and uncontrolled by the will. It is not true that we do not reason in dreams, that the exercise of the judgment is wholly suspended, and that the will is entirely powerless or ceases to act. These faculties are not altogether in abeyance, but they doze while the subordinate powers of the mind—those which play the parts of picture-carriers and record-finders—ransack the treasures of memory and mingle together in the direst confusion old things and new. Imagination is not active, but it remains just enough awake to supply the connecting links which give seeming continuity to those parts of the phantasmagoria which we chance to remember on recovering perfect self-consciousness, and which, being remembered, we call "dreams." No one remembers more than one dream, unless he has roused from sleep more than once. This experience has led to the inference that dreams only occur at the moment or in the act of awaking. There are dreams which take place in the process of returning to consciousness—for example, those instantaneous scenes and spectacles which are suggested by the sound or feeling that rouses the dreamer; but, in result of a long and close study of the subject with a view to discover the nature of dreams, and the laws of dreaming, for medical purposes, in connection with the treatment of sleeplessness, I am persuaded that dreams occur in the course of sleep and are wholly forgotten.

That they do not and cannot take place in deep sleep is probable, because deep sleep is general sleep, and when this state prevails the subordinate faculties are sleeping, and the pictures and records which compose dreams are not disturbed. To understand dreams we must understand sleep, and it is because the two phenomena have not hitherto been studied together, that so little is generally known about either.

Sleep is a function or state in which the particular part of the organism sleeping *rests*: whether it is wholly inactive depends on

the degree of rest it enjoys. Every part of the organism sleeps, and the totality of the sleep-state depends on the fact of all the important parts sleeping at the same time. If some remain awake—perhaps busy with an unfinished task, or setting about one which the will has foolishly imposed on one of the lower faculties before itself going to sleep, or, it may be, too worried to take natural rest—then the unrest of the busy or distressed faculty or faculties will render the sleep as a whole incomplete, and the repose of the actually sleeping faculties disturbed. Natural sleep is simultaneous sleep of all the faculties of body and mind; and the secret of sleeping soundly and restfully consists in so ordering the life that the higher intellectual powers, the powers of automatic activity, the senses, the muscular system, and the viscera—principally the stomach—may all be ready and able to sleep at the same time. This can only be accomplished by making the act of sleep a thing done periodically, with that rhythmical regularity which nature loves and on which the smooth working of the machinery of life depends. When sleep is natural, in the sense of being complete, dreaming is, as we have said, improbable, if not impossible; and the measure of dreaming is therefore—inversely—the measure of the integrity of the sleep enjoyed. A great dreamer cannot be in good health, or, to use a familiar expression, he "cannot have all his wits about him" when he is awake. Every faculty—by which I mean, every part of the organism which performs a distinct function—must sleep; and if it be healthy, it will sleep at regularly recurring periods. It follows that a dreamer who is not unhealthy—a *rara avis*—must have formed the habit of allowing his faculties to sleep separately; some being on duty, or watching, while others rest. As a matter of fact, most persons form this habit to some extent, and therefore the majority dream. For example, the man who works with his brain often takes little muscular exercise, and his apparatus of motion rests and doubtless sleeps while his mental faculties are in full action. It may happen that the development of this habit of separate sleep is carried to such an extent that the several centres of the brain habitually take their rest independently of each other, and at different times. The clerk will doze as he adds up his column of figures; and the copyist will go on transcribing while his centres of thought and imagination sleep. Conversely, the lower and automatic centres of the brain—or the senses—may sleep while the higher centres are awake. Much of the so-called "abstraction" and "absence" of mind we notice in ourselves and others is due to this cause. The brain-worker gains credit for being lost in thought when he does not perceive some object which ought to impress him strongly through one or more

of the senses; the farmer toiling over his fields, the hunting man weary with his day's work, the soldier exhausted by the toil of the march, will sleep so far as one set of faculties, or one part or system of the organism, is concerned, while the others are not only active, but so controlled that the subject of this partial sleep may walk or ride or go through evolutions while his mind sleeps. In short, it is possible, and easy, to fall into any habit of this class, and the inevitable consequence will be that only some of the faculties, or parts of the organism, are ready to sleep when night comes round, while those which remain awake will be unrestful and disturb the others so that they can only doze. In this state of matters, dreaming is an unavoidable experience. Meanwhile, the most highly developed and dramatic dreams occur to those whose sleep is so partial that part only—and, as it would often seem, a small part—of the brain sleeps at any one time; or, perhaps, I ought to say, at night—because it not unfrequently happens that those who dream much by night do not dream when they sleep by day. This variety of partial sleep, which tends to sever the natural connections between the several component parts of the mind, is injurious, and therefore it is, as I have remarked incidentally above, that great dreamers are, as a rule, unhealthy. It is easy to see how this must be. If the intellectual faculties are, so to say, broken up in such a way that when some are active the others are sleeping, the checks and restraints which the several parts of the mind naturally impose on each other are wanting, and any one of the faculties may become exaggerated in the exercise of its functions. The practice of dreaming will then extend to the day, and the mind may—especially if there be any inherited and constitutional lack of cohesion among the intellectual faculties—become disorganised. This is a contingency, or more than a contingency—let us say, a probability—against which the dreamer of particularly "worked-up" or realistic and elaborate dreams should be on his guard. It does not, however, follow from what I have said that the most *coherent* dreams are the worst, because the judgment may be simply dozing, and able to correct the scene or story as it passes through the mind. In that case, the severance between the higher and lower faculties will not be so great as when the incongruities of the dream are unchecked, and yet the pictures and thoughts present to the mind are especially clear and strong in their outline and colouring. Intensity without coherence is, as a rule, worse than an equal amount of vivid dreaming with more connectedness of thought. We now know something, though a very little, in truth, about dreaming, and we may pass to the consideration of our proper subject—Dreams and the making of dreams.

Dreams are re-collections, in the strict sense of that word. The pictures which have been put away in the chambers of mental imagery, the thoughts which have been recorded, as all thoughts are recorded, by the molecules of the brain in the act of thinking, the impressions left by perceptions made by the organs of sense, and by conceptions originated by the faculties of mental-sensation, impressions of feeling, together composing the records of experience, are brought out of their holes and corners, and, as it were, thrown crudely before the mind. There is seldom any clear evidence of order in the arrangement, but there is no reason why, if the collecting faculty be thoroughly awake, it should not follow beaten tracks, and arrange the pictures and records it reproduces in their natural sequence. Moreover, there is that association of ideas which forms the basis of memory, and this will almost necessitate a certain amount of connection between the elements of the most chaotic dream. All that seems to be original in a dream is due to the kaleidoscopic effect of throwing the materials of which the scene is constituted into new and startling combinations. We know how much of novelty may be produced in the accidental combinations effected by shaking together some dozen particles of coloured glass, or other small objects, in a kaleidoscope. The variety will be greater and the new combinations more surprising in the throwing together of memories in a dream, because the natural associations help to give verisemblance to the effect, and the imagination, which is seldom wholly asleep, gives finishing touches to the panorama as it proceeds. Much less, however, is due to the intervention of fancy in a dream than is commonly supposed. The great majority of the results produced are caused by the overlapping of pictures, the entangling of threads of thought, and the distortion of the original connections between ideas, pictures, and records of impressions which have either been received or put away together, or connected in previous dreams. For dreams are often, wholly or in part, reproductions of former dreams, and in process of years a mind may become expert in, or habituated to, the experience of a particular class of night visions and night thoughts. Dreams may be roughly divided into four classes: (1) Those of the present; (2) those of the past; (3) those of the future; and (4) dreams which would appear to be simply heapings together of inchoate ideas and mind-pictures, without either time, order, method, or reason. On each of these classes of dreams there is something to say, but it must be said briefly, and rather by way of suggesting inferences to other minds than in argumentative support of my own conclusions.

First, as to dreams of the *present*,—it is important to note that, though these are seldom precisely what they seem, when there is a tendency to employ very recent mental pictures, records, and impressions as the material of dreams, the faculty engaged in dream-making is either jaded or lethargic. Thus we get the same result, as regards the constituents of the dream, from two opposite causes. When that part of the brain which performs the function of re-collecting the records of memory is very weary—perhaps too distressed by excessive or disorderly work to sleep—it worries the mind with the subjects of immediately previous attention, being unable to leave them, and busying itself with them in a purposeless and distressful way, as a somnambulist or very sleepy person labours at a task he is unable to leave. The result will be a dream consisting of thoughts and scenes and impressions of the senses which, as it were, cling to the mind and will not be dismissed. There are, doubtless, especial states of the mind, or its organ, the brain, which may be loosely described as "sticky," and which create a strong tendency to dally with objects of thought and hold impressions of the senses before the consciousness longer than is necessary, instead of putting them away promptly in the memory. We know how the clumsy-fingered or bewildered workman clutches his tools and hangs over his task instead of using each tool deftly, doing each stroke of work cleanly, and passing on to something else. The same faults of method are to be recognised in the operation of many of our mental faculties, and this is one cause of dreams constructed of recent materials. Dreams of this class, as would naturally be expected, are deficient in that characteristic which is due to an active play of the dream-making faculty with the materials it employs, namely, the quality of "originality." They are apt to be little more than worrying recitals of the words spoken, the books or letters read, and reproductions of the scenes and impressions of the previous day, without much modification or embellishment. When reminiscences of this nature occur at night in the false sleep that mocks real rest, they are likely to be exaggerated and intensified in an extraordinary and generally painful degree, simply because the mind is isolated by sleep from its immediate external surroundings, and all the energy of consciousness it evolves is, so to say, turned in on itself. Dreams of the present, produced by lethargy or exhaustion of the faculty which collects and reproduces the pictures and records of memory, are generally distinguishable by their tumultuous or oppressive character. The faculty is, as it were, overburdened by the subjects it strives to manipulate. It can neither bring them fully and clearly

before the consciousness, nor can it remove them at pleasure. The mind does not so much itself hold them as feel oppressed by their presence. It would fain be rid of the thoughts and scenes pressed on its attention, not because they create a painful interest, but because they bore it. On the other hand, dreams of the present which are more directly due to the general state of mind previously described, take an agonising hold on the consciousness, and will not be shaken off, so that it struggles to be free as in a state of mental nightmare. Dreams of the present which are produced by a lethargic rather than an exhausted state of the faculty that makes them, are characterised by the slow progression of scenes and the tardy flow of thoughts rather than repetition. The consciousness seems to be in a dreamy condition, while some slow and stupid exhibitor is unfolding a story or panorama lazily. The resulting feeling is one of simple fatigue from loss of rest, rather than the head- and heart-aching, as from worry and prolonged irritation, which follow on dreams of the present which have been produced in the ways already indicated. It may be set down as a rule, that dreams of the present are of graver import as clues to the mind-state than the other classes of dreams on which we must now bestow a few moments' attention.

Dreams of the past and future do not call for detailed consideration, and may be most conveniently noticed together. When the faculty which makes dreams dives deeply among the lumber for its materials, it is either very active, and probably not sufficiently worked in the waking hours, or it has not much interest in recent events, because these have not made a very strong impression on the mind. It often happens that at a period of life when there is not any particularly keen interest in the present, the dreams are of the past. When a man is growing old, he dreams of his early life, not merely because there is in all respects a tendency to revert to the beginnings of life when the power of vitality is on the wane, but because there is a loss of interest in the present. The heat of the struggle is over and the emotions are no longer as active as they were, so that self-consciousness comes to be increasingly a retrospect of experience. Dreaming only occasionally of the past may be the simple result of the association of ideas, the dream really consisting in a present recollection of records relating to the past: but I am now speaking of the habitual reproduction of long-past and possibly forgotten pictures and records of memory in dreams. Dreams of the future are, for the most part, anticipations arising out of the affairs of the present. They are, properly speaking, forebodings, or eager foretastes, of the dreaded or desired issue of plans and experiences which belong to

the present. There is no reason to suppose that the mind is capable of prophesying while the supreme cerebral centres sleep. Most of the so-called dreams of the future are really vaticinations of the imagination while on its way to sleep or slowly emerging from the state of self-forgetfulness.

The inchoate dreams which approximate to paroxysms of delirium constitute the fourth class into which I have divided these experiences. They are often exceedingly distressing, and bespeak a troubled or disorderly state of mind, but they are not, in themselves, so threatening to mental health as certain varieties of the dream of the present to which we have already adverted. Dreams consisting of disconnected and fantastical pictures and ideas are commonly of short duration, and occur more frequently in the act of going to sleep than in that of awaking. They may be amusing or annoying; and they are not uncommonly the causes of bad sleep—or, more accurately speaking, of delay in going to sleep. The brain is awakened by the merriment or the disgust occasioned by these dreams. Sometimes the would-be sleeper rouses himself by laughing at the grotesque imagery presented to his mental vision, or the strange ideas which occur to him. The mind may be so disturbed by these awakenings, that sleep becomes impossible. Probably the most common cause of this class of dreams is an undue excitement of the organs of sense immediately before going to bed. Such dreams occur after visits to the theatre, reading novels, or hearing music late in the evening. They also frequently follow gay and dissipating scenes or experiences. The sense organs are over-excited, without being wearied, or so much agitated that they cannot rest. Except when they indicate a generally excited brain, dreams of this class are not of great moment, and are easily obviated by giving the mind regular and methodised work which lowers the excitement and induces moderate fatigue without distressing it. Sufferers from this trouble may generally cure themselves by reading aloud some not very exciting but sufficiently interesting book for half-an-hour before retiring to rest. The aim should be to give the mind a subject of thought with which it may engage its attention, and shut out the troublesome crowd of imaginings which obtrude the moment the head is laid on the pillow and the eyes are shut.

It follows from these general considerations, that dreams are made out of the pictures and records of thought, that the making of dreams must be to a much larger extent than we are wont to suppose under the control of the will. The difficulty of believing this to be the truth lies in the fact that the will is not able to call up or prevent a

particular dream or class of dreams. The making of dreams is not an affair of *now*, at any period of life. The material employed in their production is the stock of pictures, impressions, conceptions, and feelings previously accumulated. Meanwhile, he who would dream pleasantly in adult life must see to the material with which he stores his mind in youth; while, in the heyday of manhood we are heaping together the material of dreams for old age. The mind is not conscious—or does not notice—one-half the impressions it receives from its surroundings. To this circumstance, in fact, is due the surprise with which we view, as for the first time, many of the unconsciously received or treasured impressions which are reproduced in dreams, and hence the feeling that they are *original*. It is not, therefore, possible to prevent the accumulation of pictures and records which we would gladly eliminate from the stock material of dreams; but much may be done to improve the store as a whole by feeding the mind with wholesome and healthy thoughts and impressions. He who makes it a rule through life—beginning early in youth—to take care that what he puts away in his mind and accumulates is, as far as may be possible, a treasure of pure and good materials, will do much towards making the dreams that haunt his sleep in the later years of life not only tolerable, but, so far as night-thoughts can subserve any useful or beneficial purpose, improving. There can be no question that pleasant dreams sometimes afford relief to the mind, especially when they occur on awaking, or when they blot out the disagreeable impressions of the day, and facilitate the process of passing into a state of natural and complete sleep. Such dreams do not last long, and are seldom so intense as to distress the faculties. There is always a danger in light sleep of the senses being partially awake to surrounding impressions, and making them the pegs on which to hang a dream. It is, therefore, important to secure the most peaceful and negative conditions for sleep. Dreams are often made by the externals of the sleeper. To avoid this contingency, the sleeper should train his senses to disregard the external when composing himself for sleep. This is not difficult to do, if the mind is set resolutely for a few nights in succession to shut out or ignore the impressions that strive to attract it through either or all of the senses. It is happily not required of us to know the way in which we accomplish all the acts we perform; and in respect to some, it is better not to be too curious concerning the means if we gain the end. In regard to dreams and the making of dreams, it will, however, be found an advantage to be fairly well-informed.

J. MORTIMER GRANVILLE.

NOTES ON THE DUGONG.

AMONGST many promising industries that await future development in the thriving young colony of Queensland, there is one that should especially commend itself to young gentlemen of adventurous disposition and moderate capital. I refer to the utilisation of the strange creature known as the Dugong. As will presently be shown, every part of it is marketable, and its capture may be effected with but a small per-centage of the dangers and hardships of the somewhat kindred pursuit of whaling.

The existence of this marine mammal need not here be announced as a discovery, though in truth not much is known about it. Within the past twenty years it has been occasionally and briefly treated of in books and pamphlets, and it may, I suppose, be assumed that the ordinary reader is aware that our Dugong is the *Halicore australis* of Cuvier and succeeding naturalists, the Sea-cow of the Australian colonists, and the Behemoth of one or two fanciful writers, who have claimed at least as much right to bestow the Scriptural cognomen as the friends of the hippopotamus, which we were in our youthful days taught to consider the lineal descendant of the patriarchal beast that ate grass like an ox, and whose bones were as bars of iron. It is true that the dugong does graze upon submarine pastures, and that his bones ring hard as steel when struck; but the reference might be held to apply equally well to the *Halicore tabernaculi* of the Red Sea, which bears a rough family resemblance to its Australian relation.

My first glimpse of the dugong in its native element was from the deck of a yacht. The little *Fairy* had been riding uneasily during the night, chafing at her hawser like an impatient horse fretting under restraint. Towards morning the wind dropped, and the cessation of the creaking and thumping of course awakened one as effectually as if the change had been from quiet to noise, instead of from noise to quiet. The wooded islands of Moreton Bay were around us, slowly, in the hastening dawn, putting aside their vestments of faint blue gauze. The magnificent constellations of the Southern heavens were visible, but so faded and feeble that they seemed but the vanishing ghosts of themselves. The ripple of the flood tide, parting at the

bows of the yacht, and streaming with a contented gurgle along her copper sides, was the only sound.

This was the situation when I emerged from the shelter of the mainsail, arranged tentwise over the boom, and stood on deck to watch the sun rise. In those latitudes this is a very rapid process. The sea-fowl, instinctively feeling and obeying the summons, blithe in the half-born morning, flew straight from one island to another, not wheeling and vagrant as they would be later in the day, but pursuing a strictly business-like course. The water, lazily heaving its unruffled bosom, seemed to be snatching an hour of rest in anticipation of the land breezes that would soon of a certainty disturb its composure. The eastern sky assumed one by one the manifold hues of the ever-wondrous transformation, catching the first stare of the sun while as yet he was below our horizon, and blushing rose-pink in consequence. And now for the first appearance of the golden rim over the dark ridge-line of the far-off range.

Yet I after all missed that looked-for vision, for, not a cable's length astern, there came from the sea a plaintive appeal, as if a child half awakened had softly moaned, and turned over to sleep again. I looked around in time to see a clumsy greyish-brown head silently thrust above the surface, and, without leaving a sign, as silently disappear. This was a dugong taking a breath of upper air, and returning to its feeding-ground below. While I watched in the vain hopes of another glimpse, the sun had leaped clear of the hills, and all the delicate tints of dawn had died.

If, however, it was not possible to see more of the dugong alive and free in its native element, there was an excellent opportunity of looking upon its carcass, and prying into its interior mechanism. Not two leagues off lay Stradbroke Island, and, white in the sunshine, we could make out Amity Point, its huts and its signal-posts. Amity Point was the head-quarters of a dugong fishery, and the boats anchored off shore indicated that the men had returned from their night's labour. Our own hand-line fishing was over by breakfast-time, and the tide set in the right direction.

Up, then, with the anchor; haul-ho at the halyards, and let the sails take their fill of the wind, travelling in strong cat's-paw line towards us. Within an hour we had compassed our two leagues. The brown kites, big hawks, and impudent crows soaring and settling on the beach in increasing force informed us that the men had not returned that morning without a prize; and when we stepped out of the dingy upon the hard surf-varnished sand, we found two carcasses of dugong already skinned and stripped of their flesh, and one specimen, estimated

to weigh close upon half a ton, lying high and by this time dry, awaiting chopper and knife.

Now I could understand why one person had told me the dugong was like a whale; another, that it resembled a seal; a third, that it was not unlike a porpoise. The animal was in some sense a reminder of them all, but really not to be compared with either. It was perhaps likest a seal of elephantine proportions, and a baby dugong that had been taken from one of the prizes over which the carrion birds were fighting and squabbling, and that had been kept for despatch in spirits to England, would very well pass for a member of the seal family.

A tour round the mature specimen had to be twice repeated before I could see my way to a clear comprehension of its "points." Its dull brown body was like a large cylinder, tapering off towards the head and great paddle-shaped tail. Ears there were none to speak of. The eyes were tiny and three parts buried. The two flippers, considering the size of the animal, were remarkably small. The most prominent feature was the head, which terminated in a solid square-cut upper lip that warranted its comparison with a bullock. Being a female dugong, there were neither teeth nor tusks in the upper jaw, but a couple of small tusks of good ivory had been that morning taken from one of the bulls already operated upon. The inside of the mouth was lined with a rough apparatus, like a worn-down scrubbing-brush. The dugong, in short, is a vegetarian of the strictest order, and the stomach of our dead friend contained an immense quantity of vegetation cropped during the night from the bottom of the sea. It was the most curious example of the ruminating mammal I had ever seen. The skin was bare and slightly wrinkled, though at a distance it appeared to be quite smooth.

The opinion once prevailed that these representatives of the ancient sirens and mermaids must be classed amongst the whales; but modern science, through the patriarchal Owen, thus pronounces: "The whole of the internal structure in the herbivorous Cetacea differs as widely from that of the carnivorous Cetacea as do their habits: the amount of variation is as great as well could be in animals of the same class existing in the same great deep. The junction of the dugongs and manatees with the true whales cannot, therefore, be admitted in a distribution of animals according to their organisation. With much superficial resemblance, they have little real or organic resemblance to the walrus, which exhibits an extreme modification of the amphibious carnivorous type. I conclude, therefore, that the dugong and its congeners must either form a group

apart, or be joined with the pachyderms, with which the herbivorous Cetacea have most affinity."

Looking at the raw, reeking hides of the recent captures spread out upon the coarse grass of the Stradbroke shore, I could but speculate upon the curious theory which some one had propounded, that the Israelites were ordered to veil the sacred tabernacle with this description of skin. When I first read that Ruppel had conceived the idea so strongly as to feel warranted in embodying it in the nomenclature of natural history, I turned to the ornate but singularly minute account of the component parts of the tabernacle to be found in the Book of Exodus. There, strictly catalogued, we have the inner curtains of fine-twined blue, purple, and scarlet linen, and of goat's hair, and badgers' skins to cover the pavilion, together with the splendid veil concealing the holy of holies from the vulgar gaze. But I could discover no room for a dugong hide. Josephus certainly states that the richly figured and embroidered veil forming the entrance to the tabernacle was protected from sun, wind, and rain by a coarser hanging, occasionally drawn aside or rolled up. Very questionable, however, is it whether even this was of dugong leather. These hides of the *Halicore australis* were an inch thick, and this is not at all an unusual thickness. Of all the members of the order to which the dugong belongs, including, of course, the Red Sea variety, it may be said without fear of contradiction that they are not a thin-skinned race, nor the kind of purveyor to which you would go for a graceful hanging for a pavilion entrance. Still, there are many practical uses to which dugong hide may be applied in modern days, and for machinery there is nothing preferred before it.

When the dugong was hauled up on the sandy slope, a line was cut down the belly and the skin taken off in one piece, and spread out to be used as a receptacle for the meat as it was hewn from the carcass. As it happened to be a fair-sized skin, it required two men to carry it. We were afterwards shown a hide that was an inch and a half thick at the back, though the thickness had gradually diminished towards the under part of the body. The dugong hide is not, as might be supposed from its solidity, composed of gross material, for its delicate nature is such that, properly boiled down, it yields a jelly as acceptable and beneficial to invalids as calf's-foot. The gentlemen who conducted us over the dépôt at Stradbroke Island had boundless faith in the dugong hide, and believed that, reduced by machinery, it would make excellent leather for general purposes.

The flesh of the dugong next claimed our attention. It is cut off the carcass in flitches and slabs, and from the same animal is taken

meat resembling beef, veal, and bacon. I have eaten it in each form, and can testify to its excellence, and to the way in which it has been palmed off upon knowing men as prime fillets of beef, cutlets of veal, and rashers of superior bacon. If the dugong is not properly fat, it is turned chiefly into bacon; should it, however, present a layer nearly two inches thick, the snow-white fat is used for a more important purpose, to be presently described. The lean flesh, beef-like in the mature, and veal-like in the young animals, is eaten fresh or salted for food. The bacon flitch in size, colour, and streakiness, if hung in an English pork-butcher's shop, might easily be taken for a section of the side of a true Wiltshire hog; and the only difference detected in the eating would be, in the dugong, an absence of the strong flavour too often found in the pork. And a mature dugong, twelve feet long or thereabouts, would weigh nearly a ton. It is worthy of mention, too, before passing from the flesh of this animal, that the meat from the calf is always the best, and that it is recommended by the faculty to consumptive persons, by reason of its undoubted strengthening qualities. From the dugong's head the fishermen get their own quickly secured tit-bit in a happy blending of fat and lean with the gelatinous portions, which, carefully cooked, becomes, when cold, a delicious ready-made brawn. The flippers, a good deal boiled, make capital soup. The bones of the dugong, being of great density, close-grained, and capable of taking a high polish, might probably be used in substitution for ivory. The ivory tusks are in great request for knife-handles.

To this catalogue of practical uses must now be added the most valuable of them all, namely, the production of oil. Australia at the present time absorbs nearly all the dugong oil that is manufactured; but it is idle to suppose that either the capabilities of the Queensland waters for supplying the dugong, or the utilisation of the creature when captured, have been thoroughly tested: the supply is never abreast of the demand. Little is known of the habits of the dugong; the exact range of its habitat has not been defined. But the value of dugong oil is established beyond doubt. To Dr. Hobbs, an esteemed and long-resident public man in Brisbane, belongs the credit of the discovery; and his early description of the therapeutic qualities of the oil, based upon experiments with his own patients, remains not only unquestioned, but confirmed by the experience of five-and-twenty years. It possesses all the medicinal qualities of cod-liver oil, without the unpleasant taste of that familiar curative. In its pure state it can be taken without disagreeing with the most sensitive stomach. I have myself used it instead of butter

with toast; have eaten delicate pastry made from dugong lard; have fried fish with it; and, as a consequence, have never since ceased to wonder that some better effort is not attempted to make it more widely known. Consumption, the scourge of the old country, finds an unfriendly atmosphere in Queensland, where I have known consumptives, landing with the disease to all appearance hopelessly advanced, become in a few years healthy if not robust. Yet, even there, the most marvellous effects are attributed to dugong oil in cases of rheumatism, and wasting as well as ordinary consumption. I met with a well-authenticated instance of a man who was unable to take medicine or nourishment, kept alive by an outward application of the lard sediment of dugong oil. It was rubbed constantly into the skin, and lard plasters were kept on the pit of the stomach, until the patient was able to take the oil in the ordinary manner, and rejoice in ultimate recovery. And I have known ladies who shuddered at the bare notion of swallowing oil, derive benefits from its adaptation to all manner of culinary purposes.

The process of extracting the oil at Stradbroke Island was, I presume, that followed in the few stations engaged in it. If the dugong, as explained on a previous page, offered enough fatty inducement, the bacon was boiled down, and the oil run off through a tap, or removed by the more homely device of skimming. It should be quite clear, positively flavourless, and without odour; but this combination of qualities, which distinguishes it from cod-liver oil, can only be attained by the nicest "rendering." The largest quantity can be made by "trying out," which is, roughly speaking, frying in a Brobdingnagian kettle. In this way, however, the quality suffers; and thus, though boiling involves more waste, that is found to be the best—and in the long run, therefore, most remunerative—system. In cooling, a careful filtration through flannel bags is observed, and the sediment is the white lard, to which reference has been made. The yield from an average dugong would be about five gallons; and the minimum may be set down at three, and the maximum at ten gallons. The proprietors of the Stradbroke fishery were at the time of my visit mourning over the decline of prosperity, and longing once more for the time when half a dozen dugongs would be brought to land in one morning. The herds appeared to be abandoning the waters, and it was a question whether the men should not follow their example. A similar state of things was being deplored in other waters, where the author of "The Queen of the Colonies," a dugong-hunter himself, once saw a herd escaping in an

unbroken procession for three hours through a narrow tideway to the open sea.

Moreton Bay is the southernmost hunt of dugong haunts in the Queensland seas. The season there lasts through the lovely winter weather, and it is supposed that the dugongs make their way thither from more tropical seas to give birth to their young. The submarine pastures upon which they feed lie at a depth of from eight to fourteen feet, and the favourite grounds are banks protected from the sea, in bays and straits. They graze in company, and feed down the herbage so close that they leave a well-defined track to indicate their movements. The black-fellows, who love occupation of this kind, if any, peer over the gunwale of the whale-boat into the clear water, and are unerring authorities, telling at once when the monsters passed that way, though it were a week previously, and giving a shrewd guess as to their present whereabouts. Their eyesight is almost miraculous.

The recently captured specimens we saw at Stradbroke had been tracked in this way. On the morning before our arrival one of the proprietors, a well-educated and handsome young Englishman, who looked the gentleman through all his rude fisherman's equipment, sailed away with his crew of aboriginals in open boat, and found encouraging traces of a small herd of these bullocks of the sea. The sail was taken down, and strict silence kept, the dugong-hunters surmising that the game was not far distant. In that case, as the dugong has to come to the surface at short intervals to "blow," there would be an outward and visible token before long. This actually happened, and when the wind dropped and the ripples fell, one of the blacks caught sight of a dugong leisurely prowling about, deep down upon the bottom. Then stealthily the boat returned to shore, and towards evening put off again to place the strong nets, made of rope with 14-inch mesh, in a position to entangle the dugongs when during the night they came in from the sea, according to custom, to feed up the richly weeded submarine bank near shore. The upper part of the net was buoyed by logs of wood, the bottom was heavily leaded, and the whole attached to two anchors, one weighing 75 lbs., the other 90 lbs. Sometimes the struggles of the captives are rewarded by a dragging away of both anchors and nets, but on this occasion there was no such ill luck. The net, in position, presented a wall fourteen feet high and 150 yards long, and it was placed straight athwart the tide. What happened may be safely conjectured.

The dugong, in happy innocence, ate greedily of the succulent sea growths, cleaving its way in the most workmanlike manner, but

it was suddenly stopped by a strange barrier into which it had somehow thrust its bovine snout. Being a remarkably timid creature, it took fright, lost what in such creatures is tantamount to presence of mind, struggled hard, and got hopelessly entangled.

Now and then a dugong is found wrapped round as with the folds of a hammock, and the net has to be cut away piecemeal. As often as not, the dugongs thus drown themselves by frantic efforts to escape; but when a partial entanglement permits them to follow their instinct and come to the surface, they are taken alive. In the morning the boat cruises round to see how the nets have fared and to secure the game. The dead dugong is subjected to the indignity of having a slit cut through its nose, and a rope inserted through the nostrils, wherewith to tow it ashore—a very easy contrivance, to which the shape of the object readily accommodates itself. The dugongs that are found alive in their captivity struggle desperately. As a rule, they are as harmless as vegetarians are usually supposed to be, the only known breakers of the peace being a couple of bulls fighting over a sweetheart, or a frantic mother maddened by danger to her offspring. Nevertheless, although the dugong is by nature mild-mannered, and innocent of the wiles by which a Greenland whale sends a boat spinning in the air with all hands, the men prefer to give the netted individual a wide berth. Nor would it be the correct thing to slaughter it on the ground, lest the blood should attract a legion of sanguinary sharks, whose attacks would cause a speedy loss of the booty. The dugong, still floundering, is therefore hauled ashore, and a long knife applied to the throat puts an end to its career.

In the early days of the fishery the dugong was taken by the more exciting method of harpooning, and on the Wide Bay grounds, farther north, the system yet partially obtains for the sake of the sport. The blacks are very fond of this, and prove wonderfully expert in finding and striking the dugong. The extreme shyness of the beast adds to the difficulty, while it gives zest to the pursuit; and woe betide the native who dares to utter a sound, or handle clumsily the muffled oars, while the harpoonist stands like a black statue in the bows, directing, by a movement imperceptible to other than savage eyes, the course to be taken. Unerring as to time and force is the harpoon, and away rushes the boat, dragged by the swift-moving dugong along a crimson track. The pace slackens all in good time, and rarely does the victim escape. This is a modified form of whaling; but as the practice drives away the dugong, it is discountenanced by every possible means.

In waters like these, inhabited by divers creatures unknown in temperate climes, the dugong-hunter sometimes meets with strange net-fellows. In our passage across the bay on the previous evening the falling wind prevented the yacht reaching her anchorage before dusk, and the boys were deputed to keep on sounding. The lead, hurled well ahead, at one cast rattled on what sounded like the lid of a coffin, but what was in reality the convex armour-plate of a gigantic turtle, that no doubt went down as much alarmed as the youth, who fancied that we were running dead upon the rocks. The turtle, however, is a harmless intruder. Five days ago our Stradbroke friends found in the nets the makings of a fine dugong, one-third of which had been eaten by sharks. They must have attacked the carcass in a swarm, each retiring with a mouthful, and charging anew for another. The water was in a perpetual swirl when the boat approached, and the sharks cruised around, and eagerly followed the remnant as it was being towed ashore. One shark, bolder than his comrades, was not to be frightened, and a black-fellow, entering into the spirit of the game, took the shark hook and chain out of the locker, put on a bait, and cast it forth. The shark took it instanter, was firmly hooked, and towed ashore alongside the mutilated dugong. Its liver was said to weigh 95 lbs., and to have produced five gallons of oil, which was sold for lubricating machinery. Ninety-five pounds strikes one as a tolerable weight for one set of liver, but that was the assertion made and sworn to by witnesses. The curing-houses at Stradbroke were ornamented high and low with such curiosities as saw-fish and stinging rays, and there was a stuffed hammer-headed shark that had been taken out of the dugong nets, thirteen feet long, and three feet six inches across the head.

With regard to dugong fishing (or hunting) as an industry, an obvious question arises: Has it, after this long experience, grown into a profitable business? And the reply must be a qualified negative. That the industry has languished must be admitted, but there are three reasons that will assist to explain why. The colonist loves to put his capital into an assured investment, or in a venture that may reasonably be expected to yield a large profit and quick return. Land, with cattle and sheep, or, in more recent years, sugar plantations, are the favourite investments. The utilisation of the dugong has not hitherto attracted sufficient capital to give the industry a fair chance. Faith in it has been confined to a few only; knowledge respecting it is not widespread. The men who have engaged in it are not known to have made their fortunes. In a colony where mortgages and building societies give a safe eight per cent. for

money, people do not care to run risks or adventure largely. Here, then, we have the first reason. The next illustrates the folly of overweening hurry to get rich. Dr. Hobbs, before mentioned, played the part of pioneer, formed a fishing station at his own cost upon the island of St. Helena, and probably lost a good deal of money. He received a medal at the Paris Exposition of 1855 for his oil, and public attention was directed to the novelty. But by-and-by the fishery fell into other hands, and rather than admit that the supply could not be equal to the demand, the short-sighted individuals adulterated the pure product with shark oil, which is, at its best estate, altogether unsavoury. The mischief being successfully accomplished, these over-cute traders were astonished and indignant at the cessation of orders from the old country.

The imperfect appliances must also be brought into account. The oil-makers who have taken up the trade have done their best, and worked hard, but they have not gone far enough. A standing dcpôt on shore will not suffice. The dugong travels along the coast, and should be followed into tropical seas, amongst the islands recently acquired by the Queensland Government, and, if necessary, even to dangerous New Guinea. What is required is a brig or schooner fitted up on whaling principles, carrying experts who will make themselves acquainted with the best methods of extracting oil, and, for seamen and operators, picked men having a pecuniary interest in the success of the experiment. It would be easy to set up a portable boiling apparatus on shore, where wood for firing is ready to hand. There is now regular communication from Thursday Island, along the entire eastern coast of Queensland, one of whose ports should be fixed upon as head-quarters. Experience proves that the dugong will not come to the station on shore, but is, on the contrary, apt to desert once favoured haunts. The hunter, therefore, must go to the dugong.

The dugong is stated to be plentiful through the Malayan archipelago, but there would be no necessity to work so far away from civilisation, at least until the Queensland waters were exhausted. If buoyant young men, seeking an outlet for superfluous energy, and willing to embark a little capital in an enterprise that offers legitimate roving, spiced with a moderate amount of excitement, will make inquiries and procure reliable data upon this subject, I believe they will find it worth consideration. The adventurers in a dugong cruiser, well ordered and soundly appointed, would be men to be envied, even if the scheme were not crowned with brilliant immediate success.

REDSPINNER.

SCIENCE NOTES.

Atmospheric Disturbances of the Earth's Interior.

MOVING about as we do on the bottom of a great ocean of air which presses equally in all directions, and yields so readily as we pass through it, we habitually underrate its density and pressure, and an accurate and demonstrable statement of the magnitude of these is a matter of wonderment. The pressure on a dining-room table 10 feet long and 5 feet wide, amounts to above 100,000 lbs.; that on a man's body, about 30,000 lbs., varying with his superficial dimensions. On an acre of land, with the barometer at 29½ inches, it amounts to 40,120 tons, or 1,360 tons for every inch of mercury sustained in the barometer.

At the time of the recent hurricane a fall of one inch occurred very rapidly, and therefore every acre of land in Britain and around was suddenly relieved of 1,360 tons of pressure.

In the case of the dining-room table the downward pressure of the air above is exactly balanced by the elastic upspring of the air below; and as this elastic reaction diminishes in exactly the same degree as the pressure upon and around it, the table, with free access of air to each side, is not affected by the changes. Not so the cover of an air-tight box; that would be pressed downwards whenever the barometric pressure exceeded the amount which prevailed when the box was closed, and it would be pressed upwards when the barometer fell below this, as the enclosed air would then exert an elastic pressure exceeding the weight of air resting upon it. The aneroid barometer is such a box, with an elastic cover and delicate apparatus for making an exaggerated display of its fluctuations.

The whole earth is a spherical box with an elastic cover; the crust of the earth has been proved to yield to far less fluctuations of pressure than those above stated. (See following note.) Whether or not this yielding crust envelops a liquid and gaseous nucleus is still a vexed question, but the balance of evidence is in favour of the affirmative answer. Be that as it may, there certainly are cavities of various dimensions, containing air or liquids, that must

be variably compressed according to variations of outside atmospheric pressure, while their reactive energy remains the same.

It is not, therefore, surprising that some connection between earthquakes and the state of the barometer should be traceable; for if these catastrophes depend, as many suppose, on pressure of pent-up gases, this upward pressure must be more effective when the counteracting pressure of the atmosphere is diminished.

The greater frequency of colliery explosions when the barometer is low is now firmly established, and the reason is obvious—the confined gases escape more readily when subject to a smaller amount of external pressure.

Mr. Baldwin Latham has made some interesting observations, suggested by a statement of some of the long-established millers on the chalk streams, who assert that they can foretell coming rain by the increase of flow of water in such streams. He set up gauges in the Bourne flow of the Caterham Valley, near Croydon, and, selecting periods when there was no rain to vitiate his results, he found that whenever there was a rapid fall of the barometer the volume of flowing water increased, and that it diminished with a rising barometer. Deep wells were gauged, and their fluctuations were found to vary with the barometer in like manner.

Earth-tides, Earth-waves, and Earth-ripples.

WE all know that the chief tides of the ocean are produced by the disturbing gravitation of the moon; and most of those who have carefully considered the subject suspect that the so-called "solid" crust of the earth has tidal movements due to the causes that produce the oceanic tides. A committee of the British Association is at work upon the problem of detecting such tides. An account of the whole of their work could not be made intelligible within the limits of a Note; but some of the most curious of their results are within reach.

A "pendulum," or what I would rather call a plumb-bob, was delicately suspended, and a spike projecting from the bottom of the leaden weight was so connected with a little mirror that the slightest movement of the bob must turn this mirror, and thus the reflection of a beam of light thrown upon the mirror would move about as the sunbeam reflected from the bit of looking-glass, held in the hand of a mischievous boy, is made to dance on walls and dazzle the eyes of distant victims. It is obvious that a swing of the bob, too small to be at all visible by direct observation, may thus be magnified and

made easily measurable by the movement of the speck of light on a suitably situated wall or screen.

The untouched plumb-bob, instead of resting quietly in its perpendicular position, as we might suppose it would, was found to be "in incessant movement, of so irregular a character that it was hardly possible to localise the mean position of the spot of light on the screen within five or six inches." It was evident, in spite of every precaution to ensure stable foundations, that absolute stability was not attainable. Subsequent experiments confirmed this conclusion.

In one of my Notes in this Magazine of October, 1880, page 497, I described the weird movements of a microscopic bubble of air in gem cavities, and attributed them to "the tremblings of the solid earth on which it (the cavity) rested: minute, utterly microscopic tremblings, such as must be induced by every tramping foot that strikes its surface. As such blows are unceasing, these minute waves of infinitesimal earthquake would tip the little cavity from side to side, and make the bubble roll perpetually." I was not then acquainted with any of the work of this Commission. The movements indicated by their plumb-bob are exactly such as I had imagined; they are, in fact, ripples of the surface of the solid earth, nearly corresponding to the ripples or ordinary waves on the ocean, though due to quite a different cause.

By immersing the plumb-bob and line in water it was rendered practically insensible to the effect of these mere tremors, but remained extraordinarily sensitive to steady forces. By pressing the floor near the instrument, "a dimple is produced in consequence of the elastic yielding of the soil;" and thus, "when a person stood in the room at sixteen feet away from the instrument, and again at seventeen feet, the difference was rendered distinctly evident between the amounts of inclination towards the points of pressure on the *stone basement* supporting the pendulum in the two cases."

The general results of these experiments prove that the surface of the earth is in a state of continual movement, and that some movements appear to be periodical; but further observations must be very patiently conducted in order to bring out the laws of such motion, if they have any regularity.

The pendulum, skilfully applied, is a very valuable instrument of research, and I hope shortly to be able to say something about other important investigations to which it is being applied.

Electric Voting: a Political Suggestion.

ETHNOLOGISTS have hitherto divided human history into three stages: the stone period, the bronze period, and the iron period. We now appear to be entering upon a fourth, the electric period. We speak by electricity through the telegraph wire, hear by electricity with the telephone; we are to see by electricity, according to some projectors, who profess to have conveyed luminiferous undulations by means of electric impulse; we are to travel by electric railways, according to others; and Signor Roncelli, a Member of the Italian Parliament, has devised a simple and really practical method of voting by electricity.

Each Member of Parliament or other assembly has in front of him a metal plate bearing his name or number; on this plate are three buttons marked respectively—Ay, No, and Abstain. These are connected with a central printing apparatus which prints in three separate columns the ayes, noes, and abstentions, according to the buttons touched by the members, and every addition to each column moves a numbering apparatus by means of which each column automatically adds itself up as the voting proceeds.

This apparatus might be advantageously introduced at St. Stephen's in connection with the proposed measures for frustrating the obstructives. Suppose these public nuisances were doing their dirty work in a full House; the truly "honourable members" could quietly record their votes and retire. Provided a majority of the whole House did so, the record would stand in spite of the talkers, who might be left to exasperate each other or be counted out.

Telegraphic Fooling of Animals.

MC. NIELSEN, of Christiania, has described some curious effects produced on animals by telegraph posts and wires. Woodpeckers thrust their inordinately elongated tongues through the holes that are bored across the Norwegian telegraph posts, which posts are by no means limited to the railway lines, but follow nearly all the main land and water highways of the country. Bears are similarly fascinated, and do mischief by scratching away the cairn or heap of stones by which the post is supported on mountain routes where there is no soil for its insertion.

The reader may easily discover the cause of these proceedings by standing near a telegraph post and placing his ear against it. He

will usually hear a humming noise, due to the vibration of the wire, which vibration is caused by the wind, not by the electricity, as our rustics and others suppose. It may often be heard at considerable distances from the posts.

The woodpecker mistakes this for the buzz of the wood-boring beetles, &c., on which it feeds; and the bear, who is a voracious epicure in honey, imagines that he has a bees' nest somewhere inside that heap of stones, and operates accordingly, leaving the prostrate poles and other traces of his visit. Bears are now very scarce in Norway. Were they as numerous as formerly, telegraphic communication by means of wires stretched between ordinary posts would be impracticable in some parts of the country.

The effect of the posts and wires on the wolves appears to be very different. When the vote was asked at the Storthing for the construction of the first telegraph lines, a member said that, though his district would make little use of the line, he should vote for it in order to get rid of the wolves, as the farmers usually keep them off their land by setting up poles with ropes stretched between them, the wolves not daring to pass under these.

M. Nielsen states that "it is a fact that when, twenty or more years ago, telegraph lines were carried over the mountains and along the valleys, the wolves totally disappeared, and a specimen is now a rarity." This is not so easily explained as the proceedings of the woodpeckers and the bears, and may be merely a coincidence.

"Optograms."

WE have all heard something of the sensational story of the likeness of the murderer photographed on the retina of his victim, and the conviction that followed the ultra-scientific proceeding by which the picture was developed and fixed. The story has just sufficient foundation in fact to render it more delusive than a thorough-going Munchausen falsehood. There is a brilliant coat of the retina, having a colour due to what has been called the "visual purple," and this pigment is to some extent visibly impressible by light.

Professor Kühne proposed to present Helmholtz with a portrait impressed on the retina of an animal, as a complimentary acknowledgment of his researches in physiological optics, and accordingly Dr. Ayres, who is an expert in this speciality, placed a large negative portrait of Helmholtz over the eye of an animal that had been dosed with atropine (a drug which dilates the pupil by

paralysing the muscles that contract the iris), and kept it in a dark room for some hours. The retina, thus rendered sensitive, was exposed to the picture in full sunshine for four minutes.

A dull picture was found on the cornea, in front of the eye; and when the retina was examined, an image of Helmholtz's shirt-collar, and of the end of his nose was indicated by a slight bleaching of the visual purple.

As the purple during life is rapidly restored after such bleaching by light, Dr. Ayres cut off the head of a rabbit, waited till all restorative power was at an end, and then repeated the experiment. The optogram was a little better, but not a picture. The result of a number of other experiments led Dr. Ayres to conclude that no picture capable of recognition can be thus produced, and that no approach to a likeness could be traced on the retina of a person suffering sudden death, however favourable may have been the circumstances.

Microscopic Ruling.

IN the course of my early microscopic experiences I was proud of possessing a strip of glass with two crossing bands $\frac{1}{10}$ of an inch wide, each ruled with lines $\frac{1}{1000}$ of an inch apart. The little square space of intersection, $\frac{1}{100}$ of an inch across, appeared to the naked eye as a speck of ground glass, but under the microscope it revealed within it 10,000 clearly defined square spaces.

This, however, was but coarse ruling compared with the work of Nobert, who has recently died. Starting from lines similar to the above, he gradually progressed to finer and finer divisions, until shortly before his death he succeeded in ruling 20,000 distinctly separated lines within a band of the width of a Paris line, *i.e.* at a distance of only $\frac{1}{224000}$ of an English inch apart; or otherwise stated, he ruled within $\frac{1}{1000}$ of an inch space, or that lying between two of the lines of my once treasured micrometer, no fewer than 223 intermediate lines.

I have not seen this last achievement, but have no reason for mistrusting the testimony upon which the statement is founded, unless the printer has made a mistake.

The mode of ruling to, say, $\frac{1}{1000}$ of an inch is simple enough. A glass plate rests upon a stage like the table of a planing machine, with a fine-pointed diamond above it, and just touching its surface with a slight cutting pressure. Then either the diamond or the glass is moved in a straight course, and a line is ruled. A very fine screw with a large head, which head is divided on its edge into equal parts,

moves either the diamond or the glass in a direction transverse to the movement which draws the line. Suppose the screw has fifty threads to the inch, it is evident that a whole turn will advance the plate or diamond $\frac{1}{50}$ of an inch; but by means of this "micrometer head" of the screw, it may easily and accurately be moved to only $\frac{1}{20}$ of a turn, and thus the point of the screw, and whatever it pushes, will advance but $\frac{1}{1000}$ of an inch; and then another line may be drawn by again moving the glass as at first.

It is obvious that this may be carried much further by using a finer screw with a larger head, divided into 100, or 1,000, or more parts; but the limiting difficulty is owing to the necessary thickness of the line itself; and Nobert's secret—which, unfortunately, has died with him—appears to have consisted in some method of slitting the diamond into flaky splinters with inconceivably fine points, and wonderfully regulating their pressure on the glass plate.

These fine lines decompose the light that falls upon them, and produce a brilliant diffraction iridescence like that on mother-of-pearl shell, which itself is white, but is covered with nature's rulings, similar to those of Nobert, and the colours of the shell are produced by these lines decomposing the light.

Feathered Vermin and their Friends.

SOME years ago, when it was a high newspaper fashion to denounce the farmers' sparrow clubs, and advocate indiscriminate legislative protection of "small birds," on the ground that they ate caterpillars, I had the audacity to remind the writers of the fact that tigers do not feed upon roots and grass, although they have four legs like pigs and cows, and that other animals may wear feathers without eating caterpillars; and I further ventured to intimate that, as the teeth of cows and pigs differ from those of lions and tigers, so do the bills of graminivorous birds differ from the insectivorous.

My earliest experiences in domestic gardening, in a Birmingham suburb infested with sparrows, demonstrated these differences very practically. The gooseberry bushes were stripped bare by caterpillars, while the peas were being shelled and devoured by feathered vermin, whose only influence upon the caterpillars was to protect and preserve them by driving away the soft and thin-billed birds who really do feed upon insects. Had all the residents of Handsworth combined to exterminate the sparrows by means of poisoned wheat, respectable insectivorous singing birds would have supplied the places occupied by the thick-billed, seed-grubbing, pea-shelling,

blossom-nipping, cherry-stealing, cacophonous, yelping pests. I now repeat what I then said, that "the farmer kills sparrows for the same reason that he kills rats and mice, and our laws prohibiting the use of poisoned wheat *for this purpose* are as absurd as would be an Act of Parliament prohibiting the maintenance of cats and the use of mouse-traps."

Neither farmer nor farm-labourer shared the Cockney delusion of lumping all small birds together as "innocent warblers" and caterpillar-eaters. The members of the sparrow clubs, so loudly denounced from Fleet Street, all agree, and still agree, in protecting swallows, martins, robins, &c.; to destroy one of these or their nests is regarded as a sort of acrilege in all our rural districts. This is why the robin is so tame, why he regards man as his friend, and will even fly into farmhouse kitchens and pick crumbs from the floor; would do this commonly, but for his one enemy, the cat. Swallows and martins build their nests in country stables or cattle stalls within reach of the hand, and feed their young while the cow-boy is feeding the cattle. The old nursery rhyme, "Who killed cock-robin?" is an expression of the rustic love of the robin and hatred of the sparrow.

When opposing the Cockney sparrowphiles, I affirmed that "the exportation of sparrows to Australia was the culminating folly of the small-bird worshippers," and predicted the ultimate result of their introduction.

Such being my case, I now claim the right to crow, or at least to chirrup, over my opponents on reading the following in *Nature* of November 3:—"Sparrows have multiplied to such an alarming extent in South Australia, that a commission appointed by the Government have sent in a report recommending means to be taken for their destruction, and rewards to be given for heads and eggs."

Be it remembered that no sparrow existed in Australasia until they were deliberately imported there for their charming plumage, their sweet warbling, and their insectivorous usefulness. What should we say if an association of American journalists and sentimental bug-worshippers had imported to this country a thriving colony of Colorado beetles on account of their beautiful spots, their melodious buzzing, and their sanitary usefulness as feeders on sewage matter?

Aristocratic Lineage of the Scorpion.

ONLY a few of the creatures now existing on the earth can trace their ancestry in the same form as themselves far beyond the recent strata. An animal must have very blue blood indeed to

go so far back as the chalk, and find any ancestors that may be described as nearly belonging to its own species; but for any living species to be approximately represented in the rocks which are named *palæozoic* or ancient life rocks—almost amounts to a geological paradox, the term palæozoic being applied in the sense of *extinct* life rather than according to its strict etymology.

Recent explorations of the lower carboniferous rocks on the Scottish border have, however, revealed the remains of long-tailed spiders, *i.e.* scorpions, which "differ in no essential respect from the living scorpion, so far as regards external organs." Mr. Peach has recognised in these fossil insects "every structure of the recent form, down even to the hairs and hooks of the feet." The sting has not been satisfactorily traced, but the presence of the poison gland in a fossilised condition indicates the probability of its usual accompaniment.

The patriarchal scorpion has more prominent and larger eyes than his living descendants, and this constitutes his most distinctive character. Such a difference, however, does not destroy the pedigree, seeing that existing families of scorpions differ materially as regards their eyes; some have six, some eight, and others twelve. The palæozoic patriarch had at least four on each side, and two "mesial eyes" much larger in proportion than the lateral eyes; and these two were elevated on stalks, enabling the creature to look upwards, forwards, and outwards, in addition to the eightfold vigilance of the side eyes.

That which we popularly describe as the tail of the scorpion is really an elongated abdomen, and we have only to look upon the portrait of one of these unpleasant animals, and imagine the segments of the tail to be agglomerated into a globular appendage, to understand some of their relationship to spiders. Palæontologists are now agreed in regarding the scorpion as the primitive spider from which all the other species have descended.

This being the case, I am justified in pointing to the scorpion as the typical representative of a pure aristocrat, worthy of high heraldic celebration.

W. MATTIEU WILLIAMS.

TABLE TALK.

A Possible Revelation.

A SURPRISE which promises to be of highest interest to others besides the bibliophiles whom it most closely concerns, seems to be within reach. Concerning this possible surprise, however, my information is sadly vague. Such as it is, I give it. A few weeks ago a man walked into a bookseller's shop and offered for sale a book taken, as he said, from a small library which had for many generations been in his family. For a long period before the collection came into his hands, the whole of the books had, he stated, been fastened up in cases. A considerable proportion of them, moreover, were, according to his account, in black-letter. Astonished at the sum offered him for the book he brought, he refused at once to sell it or to give any further information concerning its fellows, and departed to make, as he said, further inquiries. The book he exhibited was an early copy, in fine preservation, of Shakespeare's Poems. Should this be in any sense representative of the collection, a famous prize has turned up. It is impossible to say what treasures, supposed to be irrecoverably lost, might not be stowed away in these mysterious cases. The whole story has rather a flavour of the "Arabian Nights," but I tell it as it was told to me by the bookseller to whom the prize was offered. How much, I wonder, would a volume with a presentation from Shakespeare fetch, should such be brought to light? A copy of Ben Jonson's works, on large paper (two vols., W. S. Stansby and R. Meighen, 1616–40), sold during the past month for £120. In this there occurred, in the handwriting of the author, these words: "To his most learned and honor'd friend, Mr. Edward Heyward, Ben Jonson's guift and testimony of observance."

Art in the Postbag.

I HAVE received from Messrs. Hildesheimer & Faulkner some specimens of the Christmas Cards published by them—nearly the whole of which are good in design and well printed; some of

them, indeed, might be quoted as examples of the artistic work which can be produced by making good use of the large resources now at command of the printer in colours. The *softness* of tone of most of the cards is specially to be noted.

Mr. Irving's Edinburgh Address.

IN an address to the Edinburgh Philosophical Society, Mr. Irving, the well-known actor, puts in the true light the relative aspects of society and the stage. The modern stage, Mr. Irving contends, has no need of apology. "It is never below the average moral sense of the time, and it is always a reflection of contemporary opinion." This is strictly just. The stage reflects society as it is, and is, to the nice observer, a barometer by which our progress upwards or downwards may be traced. During the last thirty years the stage has become much more cleanly, without being therefore one whit more moral. Exactly the same thing has been witnessed in our daily life. Such coarse suggestion as Wright supplied, such scarcely veiled innuendo as was rolled out by Buckstone, and such licence of behaviour as was practised by Robson, are no longer possible. Yet, in spite of our mealy-mouthedness, we accept plots which a generation ago would not have been tolerated. These are generally from the French, but that is beside the question. An advance in morality on the part of the public would find an immediate reflection on the stage. If all literature except the dramatic portion were destroyed, it would be possible from that to give a fair idea of our national advance. In France, a task almost analogous has been accomplished in "L'Histoire par le Théâtre" of M. Muret, a work to which I have had occasion to make previous reference.

The Earnings and Social Position of the Actor.

A SECOND point brought out by Mr. Irving in his Edinburgh address is the earnings of actors. There are now, Mr. Irving says, few poor actors. This is strictly true. Among the professions, acting is now probably the most immediately remunerative. A fairly clever young actor, of say five years' standing, gets an income equal to that of an average rector, and far in advance of that of a barrister or a physician of the same standing. Beside the earnings of a man like Sothern or Charles Mathews, to mention those only who have passed away, the income of a Lord Chancellor or an Archbishop seems inadequate. What is even more remarkable is that the stage,

instead of involving, as once it involved, a species of social slur, is now a passport into the highest society. At a ducal "at home" it is no unknown thing to see half a dozen or a dozen comedians; and the same class of men are seen, and sometimes under honouring conditions, in some of the most aristocratic circles in London. If the actor's profession, in spite of the increasing number of theatres, is not overstocked, it is not for want of temptations to join it.

Mr. Mallock on his Defence.

MR. MALLOCK'S Preface to the second edition of his "Romance of the Nineteenth Century" contains a defence of his work against the assault of his English critics. This is eloquent, and, to a certain extent, convincing. In America, Mr. Mallock urges, the character and meaning of his work have been subject to no such misapprehension or misconception as has here attended them. While in England the purport, and even the bare outlines of the story, have been misconceived in some quarters and misrepresented in others, the "Romance of the Nineteenth Century" has been recognised in the United States as a philosophical novel, identical in purport with the previous writings of the author. I cannot, of course, quote Mr. Mallock's analysis of his own work. His description of its purport is more to the point. "It is," says Mr. Mallock, "a study of life, with a faith in God subtracted from it. It is a study of the scientific atheism I have so often already criticised; and I have now tried to exhibit it as bearing its proper fruit." Accepting an assurance, unnecessary from the first, that the purport of the book is philosophical, I leave Mr. Mallock to settle with his censors how far the world is benefited by animated pictures of the evil consequences of heresy, put forward for the purpose of confuting heretics. Theologians and schoolmen are in favour of uprooting heresy at any cost. Individually, I am not sure that a little scepticism with regard to some matters is quite so morally misleading as Mr. Mallock thinks it. I credit him, however, with having made out very ingeniously a case for himself, and with having shown more courtesy, more tact, and more temper than are customary in literary controversy.

The Sunderland Library.

BY the time that this number of the *Gentleman's Magazine* is in the hands of the majority of its readers, the sale of the great Sunderland library will have commenced. About two years ago I

had the pleasure of inspecting a portion of the literary treasures at Blenheim, and I calculated that in one small case there were books which, if sold at the prices realised at the Roxburgh sale, would produce a sum almost fabulous. The catalogue of the first portion of the library, including letters A and B and about half C, is before me. From inspection of this, I conclude that my anticipations were too sanguine. Five leaves are missing from the Valdarfer Boccaccio (Venice, 1471), a work which in the Roxburgh sale went for the sum of £2,260. These and other deficiencies will, I suppose, prevent the volume from fetching a similar amount, even though it be, as is said, nearly an inch taller and wider than the Roxburgh copy. More than one other book of extreme rarity is described as defective. Still, there are some noble books, many of them altogether unique, and the result of the next ten days' sale will doubtless be to furnish bibliographers with a new point of departure.

Probable Profits of the Sunderland Sale.

IT is unsafe and unwise to prophesy so near the event. I will be rash enough, however, to predict that whole classes of books will sell for sums which, beside those previously given, will appear insignificant. The death of a Rothschild following upon that of a Huth, is of evil omen. As yet no younger man has sprung up to fill the gaps left by these princely collectors, and the few buyers of the most costly books are now middle-aged or elderly men whose days of enthusiasm are over. The taste for early editions of the classics is a thing of the past; and though the copies on vellum of great typographical rarities will always provoke competition, ordinary classics from the great presses of Venice, Florence, and other cities are in no such demand as formerly existed. To leave myself a loop-hole of escape, however, I will say that an occasion like the present is well calculated to revive or even to create a taste. Men are constantly led away by impulses it is difficult to explain, and a madness of competition is as well known to students of human nature as is the madness of fight—with which, indeed, it is nearly allied. By the close of the sixth day's sale the result will be declared, and the value of the entire collection may be estimated by those clever at figures.

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